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# WORK PLAN

- FOR
- WATERSHED PROTECTION
- FLOOD PREVENTION
- MUNICIPAL WATER SUPPLY

# LITTLE CLEAR CREEK WATERSHED

CRAWFORD COUNTY, ARKANSAS

*ARKANSAS*

December 1964

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## WATERSHED WORK PLAN AGREEMENT

between the

Clear Creek Soil and Water Conservation DistrictLocal OrganizationCity of Alma, ArkansasLocal OrganizationLocal Organization

State of Arkansas  
 (hereinafter referred to as the Sponsoring Local Organization)

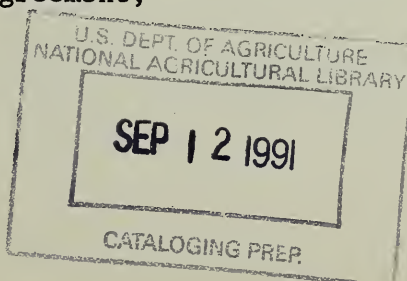
and the

Soil Conservation Service  
 United States Department of Agriculture  
 (hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Little Clear Creek Watershed, State of Arkansas under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Little Clear Creek Watershed, State of Arkansas, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;





Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about five years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire without cost to the Federal Government such land, easements, or rights-of-way as will be needed in connection with the works of improvement. (Estimated cost \$ 90,000.)
2. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.
3. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization (percent)</u>	<u>Service (percent)</u>	<u>Estimated Construction Cost (dollars)</u>
Multiple-Purpose Structure No. 1	37.62 <sup>1/</sup>	62.38	946,737
Intake Structure and Raw Water Line	100.00	0	35,500

---

1/ Public Law 566 funds, not to exceed 30 percent of the cost of the structure, will be advanced to pay the construction and installation services costs allocated to future water supply, with repayment by the City of Alma beginning when the water is first used, or ten years after the year construction is complete. (Estimated advance - \$388,989)





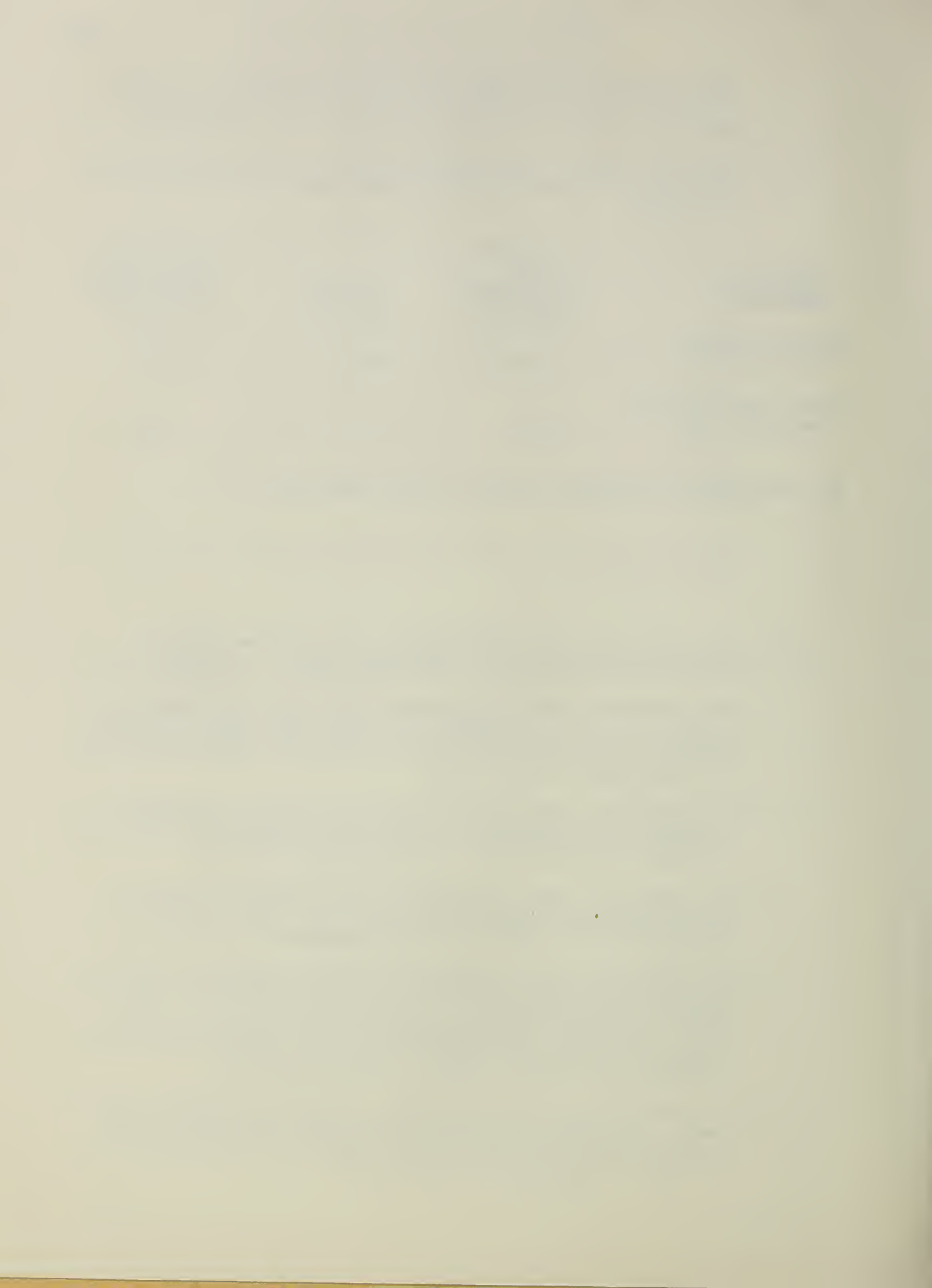
The Sponsoring Local Organization will pay all of the costs allocated to purposes other than flood prevention, and irrigation, drainage, and other agricultural water management.

4. The percentages of the cost for installation services to be borne by the Sponsoring Local Organization and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Installation Service Cost</u> (dollars)
Multiple-Purpose Structure No. 1	37.62 <u>1/</u>	62.38	255,593
Intake Structure and Raw Water Line	100.00	0	7,400

1/ See footnote 1 on page 2, item 3, of this agreement.

5. The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost \$ 4,300.)
6. The Sponsoring Local Organization will obtain agreements from owners of not less than 50% of the land above each floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.
7. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
8. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
9. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.
10. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.



11. This agreement does not constitute a financial document to serve as a basis for the obligation of Federal funds, and financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

Where there is a Federal contribution to the construction cost of works of improvement, a separate agreement in connection with each construction contract will be entered into between the Service and the Sponsoring Local Organization prior to the issuance of the invitation to bid. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.
13. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
14. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. Sec. 15.1-15.13), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.





Clear Creek Soil and Water  
Conservation District

Local Organization

By

Title

Chairman

Date

April 6, 1965

The signing of this agreement was authorized by a resolution of the governing body of the Clear Creek Soil and Water Conservation District

Local Organization

adopted at a meeting held on

April 6, 1965

(Secretary, Local Organization)

Date

April 6, 1965

City of Alma, Arkansas

Local Organization

By

Title

Mayor

Date

April 6, 1965

The signing of this agreement was authorized by a resolution of the governing body of the City of Alma, Arkansas

Local Organization

adopted at a meeting held on

April 6, 1965

(City Clerk,

Date

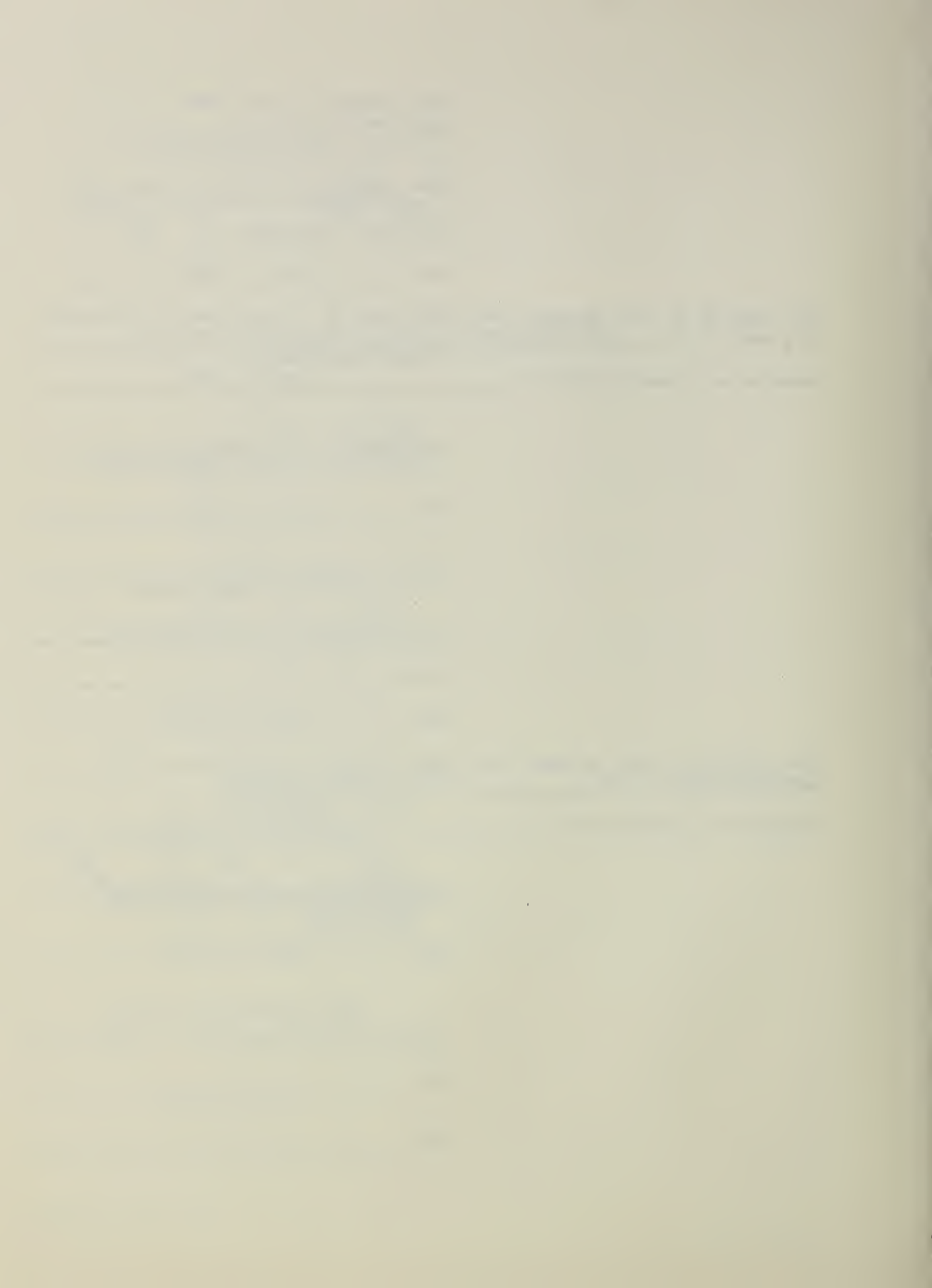
April 6, 1965

Soil Conservation Service  
United States Department of Agriculture

By

Administrator

Date



WORK PLAN  
FOR  
WATERSHED PROTECTION, FLOOD PREVENTION,  
AND  
MUNICIPAL WATER SUPPLY

LITTLE CLEAR CREEK WATERSHED  
Crawford County, Arkansas

Prepared Under the Authority of the Watershed  
Protection and Flood Prevention Act,  
(Public Law 566, 83rd Congress, 68 Stat. 666),  
as amended

Prepared By:

Clear Creek Soil and Water Conservation District  
(Cosponsor)

City of Alma, Arkansas  
(Cosponsor)

With Assistance By:

United States Department of Agriculture  
Soil Conservation Service  
Forest Service

December 1964





## WATERSHED WORK PLAN

### LITTLE CLEAR CREEK WATERSHED Crawford County, Arkansas

December 1964

## SUMMARY OF THE PLAN

### General Summary

This work plan for watershed protection, flood prevention, and municipal water supply for the Little Clear Creek Watershed was prepared by the Clear Creek Soil and Water Conservation District and the City of Alma, Arkansas. Technical assistance was furnished by the United States Department of Agriculture.

The watershed covers an area of 14,580 acres in south-central Crawford County, including a portion of the City of Alma. The Little Clear Creek Watershed is bound on the north, west, and south by Clear Creek and on the east by Little Mulberry Creek. There are approximately 1,800 watershed residents of which about 1,000 are rural and 800 live in Alma. The area is made up of about 209 farm units averaging approximately 70 acres each.

Clear Creek has flooded an average of five times a year during the period 1940 to 1959. Major floods, those inundating more than half of the flood plain, which occur on the average of twice in a 3-year period cause about 70 percent of the total crop and pasture damage. The agricultural flood plain is the 983-acre area inundated by the runoff from a 20-year event. The urban flood plain is the 200-acre area inundated by the runoff from a 100-year event.

Because of persistent low farm income, low per capita income, and high unemployment rates, the area has been declared eligible for assistance under the Area Redevelopment Act. A County Development Council has been organized for the purpose of providing local leadership and direction for economic development and social improvement as a part of the Rural Areas Development effort. A local RAD technical action panel, consisting of the United States Department of Agriculture and state agency representatives, has been formed to provide coordinated assistance to the council. An Overall Economic Development Plan has been prepared for increasing economic opportunities for low-income families, creating new jobs, developing recreational facilities, and improving the social and economic welfare of farm families.

Landowners and operators, cooperating with the local soil and water conservation district, will install and maintain land treatment measures which will have a measurable effect on the reduction of floodwater damage.

THE  
HISTORY OF  
THE  
CITY OF  
NEW-YORK  
FROM  
1609 TO 1812

By  
J. C. HEATON

1609	1610	1611	1612	1613	1614	1615	1616	1617	1618	1619	1620	1621	1622	1623	1624	1625	1626	1627	1628	1629	1630	1631	1632	1633	1634	1635	1636	1637	1638	1639	1640	1641	1642	1643	1644	1645	1646	1647	1648	1649	1650	1651	1652	1653	1654	1655	1656	1657	1658	1659	1660	1661	1662	1663	1664	1665	1666	1667	1668	1669	1670	1671	1672	1673	1674	1675	1676	1677	1678	1679	1680	1681	1682	1683	1684	1685	1686	1687	1688	1689	1690	1691	1692	1693	1694	1695	1696	1697	1698	1699	1700	1701	1702	1703	1704	1705	1706	1707	1708	1709	1710	1711	1712	1713	1714	1715	1716	1717	1718	1719	1720	1721	1722	1723	1724	1725	1726	1727	1728	1729	1730	1731	1732	1733	1734	1735	1736	1737	1738	1739	1740	1741	1742	1743	1744	1745	1746	1747	1748	1749	1750	1751	1752	1753	1754	1755	1756	1757	1758	1759	1760	1761	1762	1763	1764	1765	1766	1767	1768	1769	1770	1771	1772	1773	1774	1775	1776	1777	1778	1779	1780	1781	1782	1783	1784	1785	1786	1787	1788	1789	1790	1791	1792	1793	1794	1795	1796	1797	1798	1799	1800	1801	1802	1803	1804	1805	1806	1807	1808	1809	1810	1811	1812
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The cost of these measures is estimated to be \$88,990. The cost will be shared \$6,970 by Public Law 566 funds and \$82,020 by other sources. "Going" program assistance from the various agencies will be available to assist in the installation.

Structural measures consist of one multiple-purpose structure along with a water supply intake structure and raw water line. The estimated installation costs of these structures are \$1,296,630 and \$42,900, respectively. Public Law 566 funds will pay 62.38 percent of the construction cost, the engineering services costs, and the other installation services cost of the multiple-purpose structure. The total Public Law 566 cost is estimated at \$750,014. The City of Alma will: (1) assume financial responsibility for 37.62 percent of the construction cost, the engineering services cost, and other installation services cost of the multiple-purpose structure; (2) pay the entire cost of installing the intake structure and raw water line (\$42,900); and (3) provide all necessary easements and rights-of-way costs and administer contracts which have an estimated value of \$94,300. The city will operate and maintain these structures. The local cost of future water supply storage may be deferred; therefore, Public Law 566 funds not to exceed 30 percent of the total installation cost will be advanced to pay the local costs allocated to future water supply. The remaining local cost, including the intake structure and raw water supply line costs to be paid by the city, are to be funded by a Public Law 566 loan administered by the Farmers Home Administration. The city will repay the loan and the deferred cost of the water supply from revenues collected by the city.

The work plan provides for a 5-year project installation period. The multiple-purpose structure is to be installed during the first year. The land treatment measures will be applied during the entire 5-year period.

The planned works of improvement will reduce, by 94 percent, the area flooded by an occurrence of a 100-year flood event in the city and will provide for a 45 percent reduction in the agricultural area flooded from the recurrence of the most damaging flood during the 20-year evaluation period.

The average annual benefits accruing from the structural measures are distributed as follows:





Flood Prevention	
Damage Reduction	\$20,380
Changed Land Use	
Agricultural	820
Urban	13,520
Intensified Land Use	1,360
Municipal Water Supply	25,660
Redevelopment	2,210
Secondary	<u>5,990</u>
Total	<u>\$69,940</u>

The ratio of average annual benefits (\$69,940) to average annual costs of structural measures (\$44,383) is 1.5 to 1. The project is consistent with the President's directive and the Department of Agriculture's policy on soil and water conservation and rural areas development.

#### DESCRIPTION OF THE WATERSHED

##### Physical Data

Little Clear Creek Watershed is located in west-central Arkansas in south-central Crawford County. The watershed area comprises 14,580 acres, approximately 92 percent of which is upland area. A portion of the City of Alma is located in the watershed.

Little Clear Creek is the major drainageway of the watershed and outlets into Clear Creek at the southern watershed boundary. The watershed is bound on the north, west, and south by Clear Creek and on the east by Little Mulberry Creek. Little Clear Creek is shown as Little Frog Bayou on the older maps of the area.

Topography varies from a flat, well-defined valley along the stream in the southern portion of the watershed to high mountain ridges and narrow tributaries with steep gradients in the uppermost portions of the upland. Elevations range from about 380 feet above sea level in the bottomland to about 1,100 feet along the watershed boundary.

The watershed is divided into two major land resource areas. They are the Arkansas valley and ridges and the Boston Mountains. The Arkansas Valley and Ridges Resource Area occupies about 36 percent of the watershed and the remainder of the watershed is in the Boston Mountain Resource Area.

The watershed is underlain by unconsolidated alluvial materials of Quaternary and Recent ages and by Paleozoic age shales and sandstones.



The soils of the upland are related to the underlying parent rock units. The sandstone soils consist mainly of Locust, Jefferson, Allen, Linker, Hartsells, Ramsey, and Hector series. The shale soils are Rarden, Enders, and Montevallo series. The soils on the steep slopes have gravelly and stony textures. Soils developed over shales on gently rolling upland areas are generally fine sandy loam soils.

The major soils of the alluvial areas are the Pope, Philo, and Sequatchie series. These are deep, well and moderately well-drained, moderately permeable, sandy and silty soils on flood plains of streams.

The general hydrologic condition of the entire watershed is: good, 23 percent; fair, 26 percent; poor, 50 percent; and very poor, 1 percent. The woodland conditions (3 percent of the watershed) are as follows: poor, 55 percent; and very poor, 45 percent.

All of the land within the watershed area is in private ownership with the exception of the city property of Alma. The land use is as follows:

<u>Land Use</u>	<u>Acres</u>	<u>Percent</u>
Cropland	2,480	17.0
Pastureland	2,330	16.0
Rangeland	8,580	58.9
Woodland	430	2.9
Wildlife Land	200	1.4
Other Land <u>1/</u>	<u>560</u>	<u>3.8</u>
TOTAL	<u>14,580</u>	<u>100.0</u>

---

1/ Includes farmsteads, roads, railroads, etc.

Based on a 20-year record (1940 through 1959), the average annual rainfall is 49.41 inches, with a maximum of 74.77 inches occurring in 1957 and a minimum of 27.47 inches in 1963. The gage is located in Mulberry, Arkansas, 12 miles east of the center of the watershed.

The average annual rainfall by months, in inches, is as follows:

January	3.08	July	4.03
February	4.06	August	3.23
March	4.07	September	3.48
April	5.49	October	3.75
May	6.31	November	4.19
June	4.61	December	3.11





Mean temperatures range from 39.3 degrees Fahrenheit in January to 82.5 degrees Fahrenheit in July. The minimum temperature of record is 9 degrees below zero and the maximum is 109 degrees. The normal frost-free period of 249 days extends from March 15 to November 19.

#### Land Treatment Data

The watershed is served by the Soil Conservation Service work unit at Van Buren, Arkansas. This work unit is assisting the Clear Creek Soil and Water Conservation District.

Approximately 50 percent of the land in the watershed is covered by basic conservation plans. About 54 percent of the planned land treatment measures have been installed.

Soil surveys within the watershed are not complete but the lack of surveys is not expected to impose any limitations on the application of needed land treatment measures. It is expected that the needed surveys can be accomplished concurrently with the installation of the other measures.

Most of the land treatment measures have been installed on the upland area (table 1A) and, thus, have had a measurable effect on reducing runoff and preventing erosion. However, some areas show evidence of incomplete protection, particularly the orchards and the overgrazed pastureland. These areas will require intensive treatment if erosion is to be kept to a minimum.

Forest fire protection, forest management assistance, insect and disease control, and cooperative forestation are provided to private landowners in the watershed by the Arkansas Forestry Commission, in cooperation with the United States Forest Service, through the various federal-state cooperative forestry programs.

Fire is used fairly often by landowners on wooded rangeland with the intention of improving grazing on these areas. This practice and the wildfires that sometimes result throw an added load on the State's fire control organization. Participation in good forest management and cooperative programs for forest management is low.

#### Economic Data

The present economy of the watershed depends primarily on agricultural and agricultural-related enterprises. Farming is diversified with complementary and supplementary enterprises prevalent on most farms. Some farms are specialized, however, particularly the livestock and poultry farms. Broilers are grown under contract for integrated concerns located in contiguous counties. Most of the livestock are sold to feeders in the corn belt.



The principal cash crop is soybeans. Other crops such as corn, wheat, alfalfa, and meadow support the livestock enterprises. Truck crops are grown on a few small farms. All truck crops produced in the watershed are grown for the fresh market. Crawford County is the leading vegetable-producing county in the state.

There are approximately 1,800 residents in the watershed, of which about 1,000 are rural and 800 live in Alma.

There are 209 farm units in the watershed averaging approximately 70 acres each. Income from most of the smaller farms is supplemented by off-farm income, usually as day laborers in nearby industrial plants. According to the 1959 Census of Agriculture, 61 percent of the farm operators in Crawford County reported that their off-farm income exceeded the value of farm products sold. These figures are not significantly different from those reported in 1954.

A noticeable upward trend has occurred in the average size of farm units and the value of land and buildings in Crawford County. During the 5-year period (1954-1959) the average-size farm increased from 104 acres to 122 acres, and the value of land and buildings increased from \$8,110 to \$11,510.

Agricultural income, which exceeds the income from all other sources, was \$3,923,400 in 1959. Of this, \$1,817,300 was from the sale of crops and \$2,106,100 was from livestock and livestock products. Thirty percent of the total crop sales was from vegetables. Though most of the vegetable production occurs outside the watershed along the Arkansas River, it is expected to expand to other bottomland areas of the county.

The remodeling and expansion of the Alma Canning Company, the H and B Canning Plant in Van Buren, and the Gerber Foods Plant at Fort Smith are expected to provide an increase in demand for vegetables in the future. If flooding were reduced, parts of the flood plain of the watershed would be suitable for furnishing some of this expected increase in vegetable production.

Although more than half of Crawford County is forested, the average value of timber sales is only \$28,800, less than 1 percent of the value of agricultural production.

Tourism is an important element of the local watershed economy. Though relatively undeveloped, it appears to have potential. There is a need to develop all recreational resources. Lakes for recreation, particularly boating, are in great demand.

Crawford County has been declared eligible for assistance under the Area Redevelopment Act. A county development council has been organized for the purpose of providing local leadership and direction for economic





development and social improvement as a part of the Rural Areas Development effort. A local RAD technical action panel, consisting of federal and state agricultural agency representatives, has been formed to provide coordinated assistance to the council. An Overall Economic Development Plan has been approved. This plan stresses the need for increasing economic opportunities for low income families, creating new jobs, developing recreational facilities, and improving the standard of living of the farm families. Persistent low farm income, low per capita income, and the low employment status substantiates their eligibility for assistance. The per capita income in Crawford County in 1960 was \$675 compared with \$1,340 for the state. The median family income was \$3,120. Approximately 32 percent of the families had gross incomes of less than \$2,000. During 1960, 12 percent of the population received surplus commodities; 855 welfare cases were reported.

Unemployment and underemployment rates are relatively high. At present, 725 persons, or 15 percent of the 4,825 total work force, are unemployed. The high rate of unemployment is partially attributable to the change from a row crop economy to a livestock economy in the upland areas and the shift from primarily cotton farming to soybeans and truck crops in other areas. Farm mechanization also eliminated some jobs. Although job opportunities will be created with the expected expansion of vegetable production, additional employment is needed for the 250 persons entering the work force, annually.

The relatively high rate of underemployment occurs as a result of seasonal employment associated with the processing and canning of truck crops. The extent of seasonal work is reflected in statistical data which reveals that in 1960 only 40 percent of the work force worked the entire year; 26 percent worked less than half the time. In addition to the problems of unemployment and underemployment, the labor force is attracted to dislocated jobs. Forty-two percent of the work force travels outside the county to obtain employment.

Crawford County has experienced some serious economic problems in recent years. The drought and depression of the 1930's, the population loss resulting from the expansion of defense industries during the 1940's, and the abandonment of uneconomical farm units has reduced the tax base source of income. As a result, funds to finance community facilities and development projects have been limited.

Only recently has community development shown much improvement. The City of Alma has constructed new secondary and elementary schools (additional educational facilities are being planned). The main street in Alma has been widened, resurfaced, and provided with curbing. Fire protection is increased with one additional truck and associated equipment. The county plans a road improvement program of 20 miles, annually. Expansion of park facilities and recreation areas is being anticipated.





Plans have been developed to construct a new sewage disposal plant. The system is designed for a population up to 20,000 persons. Expansion of the present water system is being planned also.

The local development council, in cooperation with the City Planning Division, University of Arkansas, and the Arkansas Industrial Development Commission, has prepared preliminary plans to provide facilities for industrial, commercial, and residential development. Areas designated for development include 200 acres in the flood plain.

Alma, population 1,370, is the principal trade center for watershed inhabitants. It provides retail, wholesale, and professional services associated with an agricultural economy. Public communications such as telephone and daily newspaper are located here. Transportation facilities include bus and rail service and trucking companies for local and long distance hauling. Educational facilities include elementary and secondary schools. Financial institutions include the Commercial Bank. Other community facilities, including churches, a library, civic clubs, fraternal organizations, youth organizations, charitable and welfare agencies, and minor recreational facilities, are located in Alma. Major recreational facilities that provide fishing and hunting occur in lakes and uninhabited forested areas located approximately 60 miles away. Van Buren, the county seat, and Fort Smith are the major markets for the watershed products.

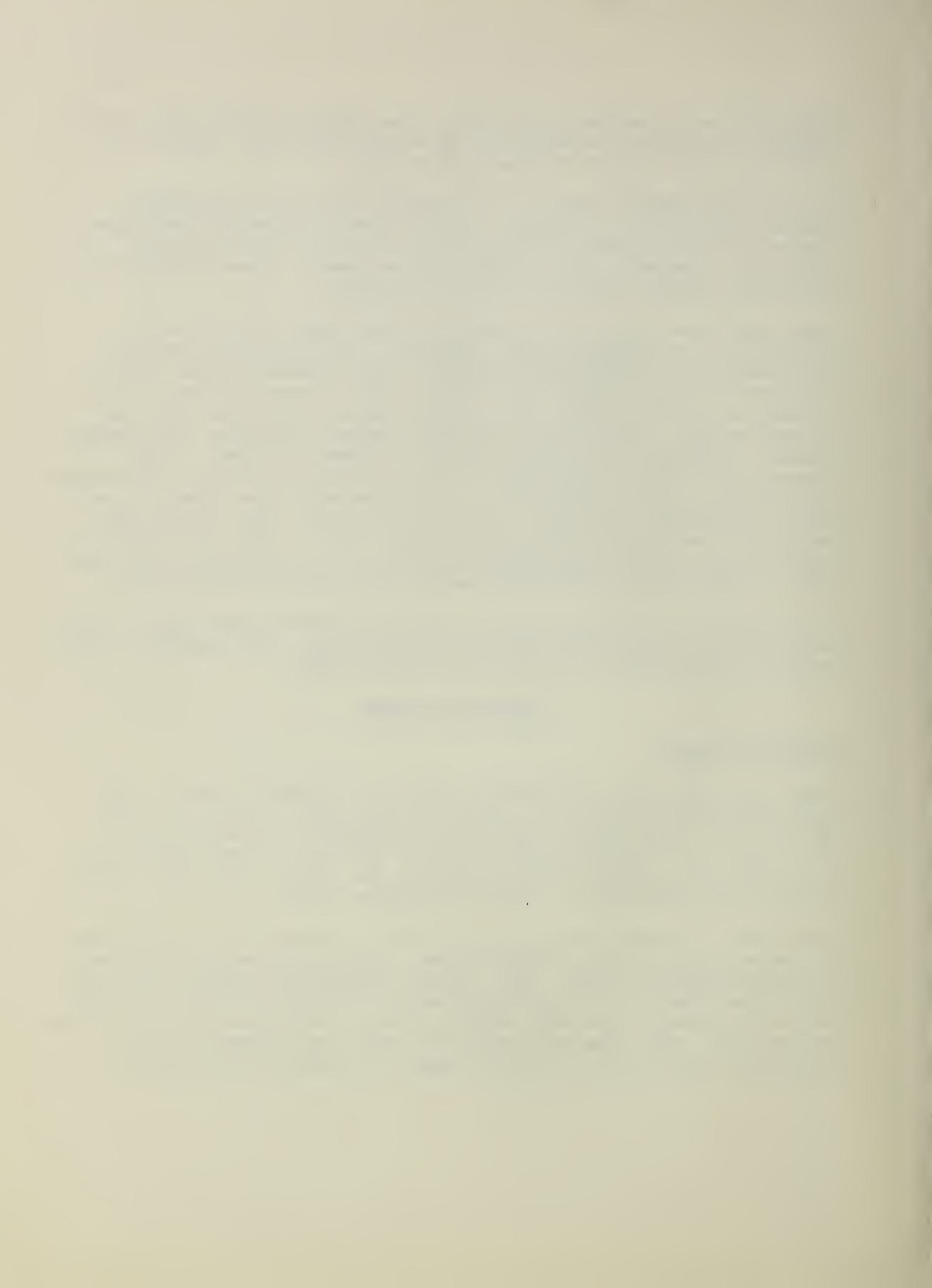
The watershed is served by 12 miles of well-maintained, hard-surfaced roads and 90 miles of county-maintained, unimproved roads. This system of roads provides accessibility to all parts of the watershed.

#### WATERSHED PROBLEMS

##### Floodwater Damage

There are 1,183 acres of bottomland subject to floodwater damage. The flood plain includes 200 acres within the city limits of Alma, of which 160 acres are being used for agricultural purposes. The agricultural flood plain, as described in this plan, is the 983-acre area inundated by the runoff from a 20-year frequency flood. The urban flood plain is the 200-acre area inundated by a 100-year frequency flood.

The records of rainfall for the period 1940 to 1959 were used to determine the extent and severity of flood damages. During this period, there were 93 damage-producing floods. The 27 major floods which inundated more than half of the flood plain caused approximately 70 percent of the total crop and pasture damage. The most damaging flood in the 20-year period occurred in June 1945. The damage from this flood under the present state of development and exclusive of urban damage is estimated to be \$26,670.



Efforts to control or prevent flooding in the watershed have been localized. Individual farmers have attempted to alleviate some of their own flood problems. Levees were constructed along the stream at one location to protect high-valued agricultural land. In another area, a concrete revetment was constructed to prevent the channel from taking a new course and destroying a productive field. A levee was built at this same location. At another location, the channel which was improved to facilitate the removal of waste water from a now abandoned packing plant has relieved flooding. Although these improvements have reduced localized damage, particularly damage from the smaller floods, they have had little effect considering the total damage.

Flooding occurs frequently causing moderate to severe damage to agricultural property. Channel capacities are small and stream gradients are relatively steep; consequently, a large portion of the flood plain, particularly the area susceptible to frequent flooding, has been converted to pasture. The only areas farmed intensively are those protected by individual levees. Other areas have been allowed to grow up in brush. If flooding were reduced, intensified agricultural production would be possible. Pasture improvement programs could be implemented; feed grains and silage could be grown to support the livestock industry. Crop rotations and improved farming methods could be employed. Agricultural resources lost because of flooding could be utilized effectively for enterprise expansion and farm and home improvement.

Floodwater damage in the urban area of Alma has, on occasion, been quite extensive. Although significant urban damage does not occur until an approximate 5-year frequency, damage from larger floods increases rapidly. Considering the relatively undeveloped urban flood plain, it is estimated that the 100-year frequency flood would cause damage in excess of \$30,000.

In addition to the direct floodwater damage, other floodwater problems exist. Areas in and adjacent to Alma cannot be utilized for residential, commercial, and industrial development because of flooding. These areas would be desirable locations for development if flooding were reduced and adequate water were available. The county-maintained roads which cross the flood plain have not been improved. County officials consider it inadvisable to improve roads when flooding is so frequent and so severe. At one location, which is a mail and school bus route, the creek must be forded.

Indirect damages such as interruption of travel, losses sustained by businesses, extra feed and care of livestock during and immediately following flooding, temporary dislocation of persons from work, extra time and travel required for delivering farm products, transporting school children, and delivering mail are quite costly.





### Sediment Damage

Overbank deposition affects 129 acres of the flood plain along the main channel of Little Clear Creek. The damages from this sediment problem are equivalent to an annual loss of \$2,210 of agricultural production on the flood plain.

### Erosion Damage

Erosion damages occur on the upland as sheet erosion and on the flood plain as scour erosion. The present rate of erosion in the upland is approximately 1.76 tons of erosion per acre, annually. The expected future rate of erosion is approximately 1.5 tons of soil loss per acre per year.

There are 308 acres of the alluvial flood plain damaged by scour erosion. This amounts to an equivalent of \$4,740 damage to the flood plain each year.

### Problems Relating to Water Management

The City of Alma requested that investigations be made to determine the feasibility of including water for municipal and industrial purposes. At present, Alma is purchasing surplus water from the Fort Smith system. Water is supplied to Alma by two 8-inch lines. Except for periods of drought and considering only the present consumption, this source has been generally adequate. However, there is an increased demand for water to serve additional meters and facilitate proposed municipal and industrial expansion. Heretofore, industrial expansion has been curtailed because of the lack of assurance that adequate water would be available from Fort Smith. Likewise, the growth of present industries in Alma has not been possible. It is reported that the present supply serves approximately 690 meters plus water for the two small industries. There is an additional potential of 100 customers.

Water rationing is necessary to some degree nearly every year. Limitations on use for domestic purposes are imposed first. During the period of rationing, water for such purposes as gardening, lawn maintenance, and auto washing are prohibited. Industrial production would be curtailed also if it were not for the fact that the plants' demands for water are usually lowest during the rationing period.



The following table gives the rate of water consumption for the period 1952 to present, with projections to 2005. These data were prepared by James Mickle Associates, consulting engineers:

Water Consumption - Average Daily Use			
Year	: Million Gallons	: Year	: Million Gallons
1952	0.348	1980	0.900
1957	0.424	1985	1.050
1962	0.361	1990	1.200
1963	0.430	1995	1.350
1965	0.500	2000	1.550
1970	0.625	2005	1.750
1975	0.750		

The City of Alma presently purchases water for 6 cents per 1,000 gallons. This contract expires in 1965. The new contract reportedly will be about 50 percent higher. These agreements which are surplus water contracts give the City of Fort Smith the right to limit both usage and number of customers. Fort Smith has forbidden new connections to the Alma system.

These circumstances have limited the growth of Alma. Local sponsors recognize that if Alma is to accomplish the Comprehensive Development Plan now being prepared by the City Planning Division, University of Arkansas, an independent water supply must be developed.

#### PROJECTS OF OTHER AGENCIES

The Shibley Grade Separation - Alma, a part of Interstate Route 40, is located about 2,300 feet downstream from the multiple-purpose structure. The grade separation provides access to and from U. S. Highway Number 71, a major north-south thoroughfare. U. S. Highway 71 and the channel of Little Clear Creek are parallel and adjacent at this location. There are four bridges of the interstate project which cross the Little Clear Creek channel. They are the "approach" ramp and the "off" ramp east of U. S. Highway 71 and both the east- and west-bound traffic lanes of Interstate Route 40. Plans for this section of Interstate Route 40, which include a realignment of the creek channel, are nearly complete. The bridge contract is scheduled for letting for about April 1, 1965.

Clear Creek, the outlet for the watershed, discharges into the Arkansas River about 1.5 miles below the watershed. The Corps of Engineers is developing the Arkansas River for navigation and other purposes. This development is not expected to adversely affect the Little Clear Creek Watershed Project.





## BASIS FOR PROJECT FORMULATION

The sponsors' objective of providing 100-years' flood protection to existing urban values and the undeveloped flood plain of Little Clear Creek in and adjacent to the city complements the city's growth potential. The growth potential of the City of Alma is based on its favorable location with respect to Interstate Route 40, U. S. Highways 71 and 64, the Arkansas River Navigation project, the Missouri Pacific Railroad, and the metropolitan area of Fort Smith.

Alma's water supply is provided by a surplus water contract which, in recent years, has resulted in the city's agreement not to make any additional connections to their water system and to require the City of Alma to restrict the usage of water to existing industrial and domestic customers. The City of Alma has concluded that in order to provide its citizens with an assured and dependable source of water for present and future needs, it must develop its own surface water supply. A consulting engineering firm made studies which indicated that sufficient water supply storage for the city's needs, until the year 2005, could be provided by the multiple-purpose structure.

Agricultural values in the flood plain below Alma are subject to considerable damage from flooding. The sponsors are aware of the need for a level of agricultural protection commensurate with the other risks of agricultural production and are cognizant of the need for applying all land treatment measures which increase the protection and efficient use of land resources.

The "agreed-upon" project development, in addition to providing adequate land treatment, will provide needed flood protection for agricultural values, flood protection of existing urban values, needed urban expansion, and an adequate municipal water supply.

## WORKS OF IMPROVEMENT TO BE INSTALLED

### Land Treatment Measures

An effective conservation program, based upon the use of each acre of agricultural land within its capabilities and its treatment in accordance with its needs for production and improvement in the chosen land use, such as is now being carried out by the Clear Creek Soil and Water Conservation District, is necessary for a sound program for watershed protection and flood prevention. Basic to reaching this objective is the establishment and maintenance of all soil and water conservation measures essential to proper land use and treatment. The extent of needed land treatment measures which have been applied to date within the watershed represents an expenditure by landowners and operators of approximately \$173,650 (table 1A).





The accelerated application and continued maintenance of land treatment measures is particularly important for the protection of the 9,300 acres of agricultural land above the planned multiple-purpose structure. These measures will provide on-site benefits, reduce the capacity which must be provided in the structure for sediment accumulation, and reduce runoff. The area which is not controlled by the structure produces runoff that contributes to floodwater damages. Land treatment measures on the uncontrolled areas will reduce runoff and consequent floodwater damage on the 1,183 acres of flood plain.

Table 1 includes estimates of the acreage in each major land use which will receive accelerated land treatment during the 5-year project installation period. These measures will be established and maintained by the land-owners and operators as a part of the "going" district programs. In addition to the presently available technical assistance, \$6,970 will be available from Public Law 566 funds to accelerate the establishment of these practices. Approximately \$2,000 will be provided to complete essential soil surveys in the watershed. It is expected that 13,380 acres will be remapped from accelerated funds and 1,200 acres from the "going" program funds.

The trend in the upland portion of the watershed is toward the retirement of cultivated land to pasture. An estimated 510 acres of upland will be planted to pasture and hayland. An additional 325 acres of pasture and hayland will be renovated. These practices will be supplemented by the establishment of farm ponds, pasture and range proper use, rotation grazing, range deferred grazing, and brush and weed control.

Conservation cropping systems, contour farming, cover and green manure crops, crop residue use, grasses and legumes in rotation, contour orchard and small fruit, row arrangement, and gradient terraces will be used on the cultivated area of the watershed. These measures will provide the needed protection for reducing runoff and preventing future erosion problems.

Wildlife habitat preservation measures to be employed on 80 acres of land will furnish food and cover for wildlife.

The land treatment measures combined with improved protection will reduce erosion, sediment production, and storm runoff, and will aid in the recharge of ground water for improved plant and tree growth. The forest litter under good watershed management protects the soil and is a source of humus which is responsible for improved infiltration, percolation, and water storage. A good humus layer provides the nutrient materials for improved tree growth. About 90 acres will be treated for hydrologic stand improvement. Hydrologic stand improvement will be achieved with the release of good, young hardwood growing stock now on the ground. Control of grazing will be necessary on the areas treated for hydrologic stand improvement.



## Structural Measures

The structural measure consists of one multiple-purpose structure for flood prevention and municipal water supply. The water supply pool, including the area reserved for sediment and municipal storage, will inundate 65 acres of flood plain and 56 acres of upland. An additional 83 acres of upland will be inundated by the flood pool.

The multiple-purpose structure will have a total capacity of 8,640 acre-feet. This includes 3,250 acre-feet of municipal water, 390 acre-feet of sediment storage, and 5,000 acre-feet of floodwater detention storage. The sediment storage provided will be adequate for 100-year project life. Floodwater detention capacity expressed in inches of runoff from the area above the structure is 6.45 inches.

The principal spillway will include a drawdown slot and a drain valve to permit the manipulation of water levels for weed and mosquito control. These devices will also make possible fish management operation.

The installation cost of the multiple-purpose structure is estimated to be \$1,296,630. The city is to install a water intake structure and a raw water line separate from the multiple-purpose structure at an estimated cost of \$42,900.

The structure is shown on figure 4, the project map. Figure 1 shows a typical section of a multiple-purpose structure. Plans for a typical structure are illustrated by figures 2 and 2A. More detailed information on quantities, costs, and design features are given in tables 1, 2, and 3.

### EXPLANATION OF INSTALLATION COSTS

The total installation cost of the project is estimated to be \$1,428,520, of which \$756,984 will be paid by Public Law 566 funds and \$671,536 will be borne by other funds. Included in total costs are land treatment measures, \$88,990, and structural measures, \$1,339,530.

Land treatment costs will be shared \$6,970 by Public Law 566 funds, and \$82,020 by other funds. Other funds include \$5,670 for technical assistance through the regular program of Public Law 46, and \$900 for technical forestry assistance on private lands by the Arkansas Forestry Commission, in cooperation with the United States Forest Service under going Cooperative Forest Management Program.

To accelerate the installation of the land treatment measures, Public Law 566 funds will pay \$1,820 for soil surveys, and \$5,150 for other technical assistance by the Soil Conservation Service.





The Use of Facilities Method was used to allocate joint costs between purposes in the multiple-purpose structure. The installation cost was divided on the basis of capacities provided for flood prevention and sediment (62.38 percent) and municipal and industrial water (37.62 percent). The installation cost (\$42,900) of the inlet structure and raw water line was allocated to municipal and industrial water supply. Structural measures costs will be shared \$750,014 by Public Law 566 funds, and \$589,516 by other funds. Public Law 566 funds will include \$590,575 for construction costs, and \$159,439 for installation services. Other funds will include \$391,662 for construction costs, \$103,554 for installation services, \$4,300 for administration of the contract, and \$90,000 for easements and rights-of-way. Included in the costs of easements and rights-of-way are land, legal fees, and building relocations.

The engineer's cost estimate and contingency allowance of 10 percent is considered realistic and provides a reasonable allowance for unexpected costs.

The estimated schedule of obligations for the 5-year project installation period covering the installation of both land treatment and structural measures, is as follows:

Schedule of Obligations				
Fiscal :		: Public Law :	Other :	
Year :	Measures	: 566 Funds :	Funds :	Total
		(dollars)	(dollars)	(dollars)
First	Land Treatment	2,300	16,100	18,400
	Easements and Rights-of-Way	-	90,000	90,000
	Installation Services	159,439	103,554	262,993
	Multiple-Purpose Structure	590,575	356,162	946,737
	Inlet Structure and Raw			
	Water Line	-	35,500	35,500
	Administration of Contracts	-	4,300	4,300
Second	Land Treatment	1,300	18,000	19,300
Third	Land Treatment	1,300	18,000	19,300
Fourth	Land Treatment	1,300	18,000	19,300
Fifth	Land Treatment	770	11,920	12,690
TOTAL		756,984	671,536	1,428,520



This schedule may be adjusted from year to year on the basis of any significant changes in the plan found to be mutually desirable and in the light of appropriations and accomplishments actually made.

#### EFFECTS OF WORKS OF IMPROVEMENT

In the 20-year period used to evaluate present damages, there were 27 major floods and 62 minor floods. As a result of the installation of land treatment measures and the proposed structural measures, 26 (84 percent) of the major floods will be reduced to minor floods. Although none of the minor floods will be eliminated, they are expected to be greatly reduced.

After the installation of the combined program of land treatment and structural measures, 1,183 acres (200 of which are in the city limits of Alma) of flood-plain land will be benefited.

The project will directly benefit the owners and operators of an estimated 31 farms within the agricultural flood plain and the owners and occupants of business and residential units in Alma.

The project will eliminate flooding in Alma except for a small area above the railroad which is influenced by an uncontrolled tributary. The area flooded by the 100-year event in the city would be reduced from 200 acres to 11 acres, a reduction of 95 percent. The areas of remaining inundation will consist of low-lying nonimproved property shown in figure 3.

Average annual acres of agricultural land flooded will be reduced from 1,700 acres to 438 acres, a 74-percent reduction.

The most damaging flood during the 20-year period will be reduced from 1,123 acres of agricultural land below Alma to 616 acres, a reduction of 45 percent.

The installation of multiple-purpose structure is expected to reduce, at Interstate Route 40, the peak discharge of a 50-year event (the design storm for the highway) from 10,511 c.f.s. at an elevation of 433.5 feet to a 1,885 c.f.s. discharge at 429.4 feet. This modification of the design storm could result in reducing bridge length or the substitution of box culverts for the four bridges.

After the installation of the project, damage to roads and bridges in the flood plain will be reduced greatly. This reduction in flood hazard will enable the county to maintain roads in better condition, thereby reducing the funds needed for repairs and making them available for additional construction. As a result, transportation within the watershed will be much improved.





Protection provided by the project will enable farm operators to restore much of their flood-plain land to profitable crop production. High-value crops such as vegetables will replace some of the comparatively low-value crops now grown.



The above photograph shows the damages which resulted from the April 3, 1964 storm in the area between the proposed route of Interstate Highway No. 40 and U. S. Highway No. 64. After the project is installed, this type of damage will be virtually eliminated.

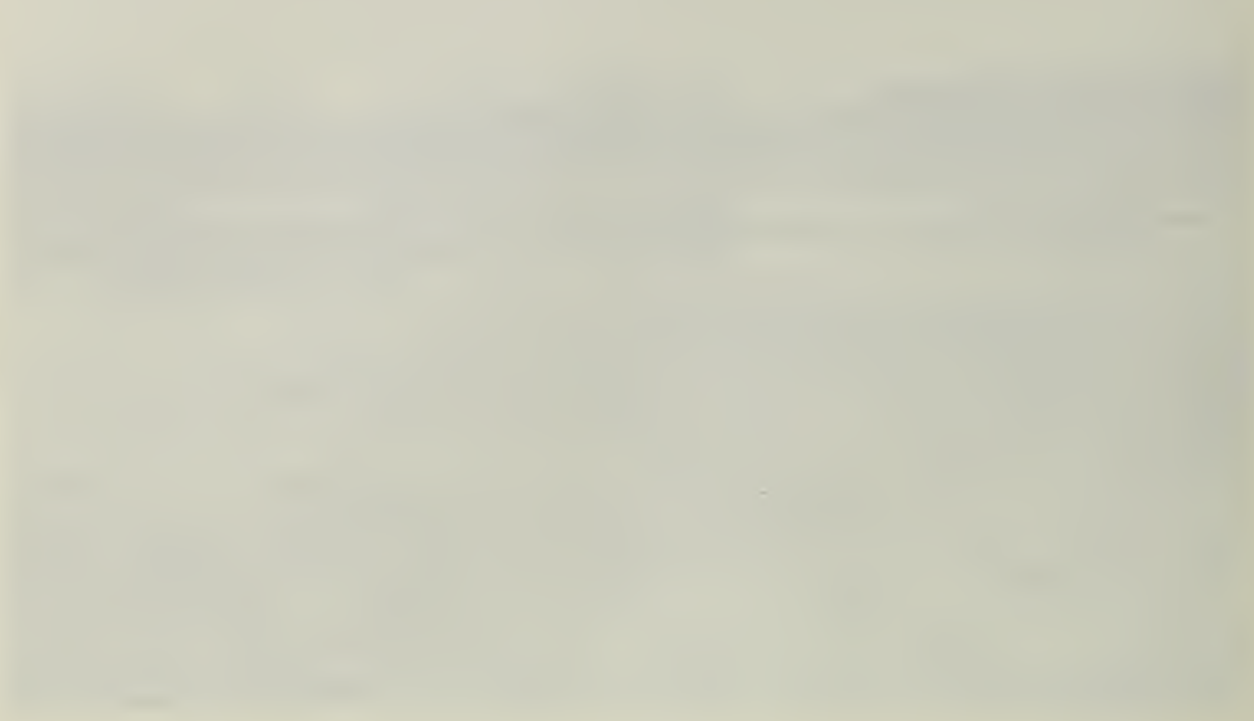
Fishing in farm ponds and Little Clear Creek plus hunting of small game are the principal recreational uses of the watershed. This use is confined to the local people.

It is anticipated that a recreational area located just below the dam will include a swimming pool and city park. The recreational uses that will result would not be possible without the water supply that will be furnished by the construction of the structure; however, these uses have not been evaluated.

Land treatment measures to benefit wildlife will establish better food and cover conditions for farm wildlife such as bobwhites, doves, and rabbits.

The additional farm ponds which will be constructed during the development of the watershed will add to the over-all fishing potential of the area.





The following table shows the results of the experiments conducted on the various specimens of the material under investigation. The data is presented in a tabular format, with columns for the specimen number, the test conditions, and the resulting measurements. The table is organized into three main sections, each corresponding to a different type of specimen. The first section deals with the results of the tensile tests, the second section with the results of the compression tests, and the third section with the results of the shear tests. Each section contains a detailed description of the test procedure and the specific parameters that were varied during the experiments. The data is presented in a clear and concise manner, allowing for easy comparison of the results across the different specimens and test conditions. The table is organized into three main sections, each corresponding to a different type of specimen. The first section deals with the results of the tensile tests, the second section with the results of the compression tests, and the third section with the results of the shear tests. Each section contains a detailed description of the test procedure and the specific parameters that were varied during the experiments. The data is presented in a clear and concise manner, allowing for easy comparison of the results across the different specimens and test conditions.

Municipal Water Supply - The consulting engineer for the City of Alma furnished the Soil Conservation Service with a water usage table based on the estimated growth of the city. Projections of future water usage of the city indicate that the proposed multiple-purpose structure will have sufficient water storage to provide a firm yield of 1.75 MGD during a drought with a return period of 30 years.

A major portion of the flood-plain scour and overbank deposition will be eliminated by the control of flooding on the bottomlands. With the project installed, the flooding will be reduced to much less frequent flooding, less depth, less velocity, and less duration of flow; therefore, scour damage to the land will be reduced. Also the virtual elimination of sediment contribution from the upland by land treatment and structural control will reduce overbank deposition on the bottomlands.

#### PROJECT BENEFITS

The total estimated benefits accruing to the structure, included in this plan, will amount to \$69,940, annually. Of the total benefits, \$61,740 are primary and \$5,990 are secondary. The primary benefits are \$20,380 damage reduction; \$14,340 changed land use; \$1,360 intensified land use; and \$25,660 municipal water. In addition, annual redevelopment benefits in the amount of \$2,210 will accrue.

Damage reduction benefits accruing to the structure are as follows:

Crop and Pasture	\$11,720
Other Agricultural	1,290
Road and Bridge	920
Urban	1,550
Overbank Deposition	720
Erosion	2,320
Indirect	<u>1,860</u>
Total	<u>\$20,380</u>

All benefits were converted to long-term prices, as projected by ERS, September 1957.

The combined program of land treatment and structural measures will reduce the average annual floodwater, sediment, erosion, and indirect damages from \$31,420 to \$9,050, a reduction of 71 percent. Floodwater damage from the 1945 flood, the largest used for evaluating agricultural damages, will be reduced from \$26,670 to \$11,660, a 56 percent reduction. Damage reduction benefits resulting from the installation of land treatment measures will approximate \$1,990, annually. The land treatment benefits were not used for project justification.



Since Crawford County has been designated under the Area Redevelopment Act as an area of chronic underemployment, redevelopment benefits were calculated and used for project justification. All redevelopment benefits are confined to local underemployed and unemployed labor.

Appropriate amortization factors were used to convert redevelopment benefits accruing from project construction and operation and maintenance to annual equivalents, giving consideration to the installation period and project life. Benefits from operation and maintenance were discounted to account for their being limited to 20 years. The average annual value of redevelopment benefits is estimated at \$2,210.

It is recognized that the storage of water for municipal and industrial uses will permit commercial, industrial, and residential expansion, and that additional redevelopment benefits will accrue from the subsequent increase in local labor. However, no assurance could be obtained as to the time and extent of these developments; consequently, redevelopment benefits from the use of this labor have not been included.

Local secondary benefits will amount to \$5,990. These benefits result from increased sales of items stemming from the project, together with increased sales and services of items induced by the project. Secondary benefits from a national viewpoint were not considered in the economic evaluation. Indirect and redevelopment benefits were excluded in calculating secondary benefits. Secondary benefits were used for project justification.

Other tangible benefits will result from reduced construction costs of the bridges spanning Little Clear Creek on the proposed Interstate Route 40. The present design of the four bridges requires two 205-foot, 5-span, double-lane, concrete bridges and two 3-span access bridges. The reduced flow provided by the project will permit the use of considerably smaller structures. Although this reduced cost is a direct primary benefit, it has not been used for project justification since the saving is contingent upon the final approval of this plan and local assurance that the multiple-purpose structure would be built prior to the bridge construction.

Agricultural enhancement benefits resulting from changed land use and intensified land use are expected to average \$2,180, annually. These benefits are based on improved land utility and reflect increases consistent with the present trends in agricultural production. Although a small increase is expected in the acreage of some surplus crops, the increased production is for farm use. A total of 245 acres of agricultural land will be enhanced.

Enhancement benefits in the urban area of Alma result from changing land from agricultural to urban uses. These benefits are based on the increase in land values brought about by flood protection. The estimated value of urban enhancement benefits is \$13,520. A portion of these benefits (\$940) results from reduced cost of fill and landscaping at an already located commercial establishment. All urban enhancement benefits are exclusive of





the damage reduction benefits claimed for future development without a project.

In addition to the benefits for which a monetary value can be assigned, substantial increases are expected in opportunities which will relieve underemployment and unemployment, promote investments in both the rural and nonrural economies, provide greater opportunity for the expansion of locally-owned businesses, and permit shifts in agricultural and nonagricultural resources to meet future demands. These will provide better living conditions, increase security, and preserve the family-farm pattern of American agriculture.

### COMPARISON OF BENEFITS AND COSTS

The average annual cost of the structural measures (amortized installation cost plus operation and maintenance) is estimated to be \$44,383. This cost includes the annual equivalent cost of the inlet structure and raw water line. The structural measures are expected to produce annual benefits, excluding secondary benefits, of \$63,950 or \$1.44 for each dollar of cost. The ratio of total average annual benefits (\$69,940) to average annual cost of structural measures (\$44,383) is 1.5 to 1 (table 6).

### PROJECT INSTALLATION

Federal assistance will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666), as amended. The Soil Conservation Service will provide technical assistance in planning, design, preparation of specifications, supervision of construction, preparation of contract estimates, final inspection, execution of certificates of completion, and related tasks for the establishment of the planned work eligible under Public Law 566.

Land treatment measures for watershed protection on privately-owned land will be established by the owners and operators. The soil and water conservation district, with technical assistance from the Soil Conservation Service, will assist in the planning and application of these measures. Additional technical assistance will be provided to enable farmers to apply the planned measures during the 5-year project installation period. A part of the technical assistance will bring soil surveys up to an adequate intensity for use in applying the land treatment measures. It is estimated that mapping will be required on 14,580 acres.

The sponsors of the watershed project will encourage owners of woodland to apply and maintain the forestry watershed management measures. Trained personnel of the Arkansas Forestry Commission will advise and assist the sponsors in this matter.

During the installation period, the Arkansas Forestry Commission, in cooperation with the United States Forest Service, will provide technical assistance to accelerate forest land treatment. These services will be provided under the going Cooperative Forest Management Program. The



forester assigned to the project will be trained in watershed management and will assist the landowners in planning and installing the forestry measures for the watershed program. After project installation, technical forestry assistance will be available under the going Cooperative Forest Management Program.

The City of Alma will secure the necessary land, easements, and rights-of-way for the multiple-purpose structure and provide the following items:

1. All necessary legal, administrative, and clerical personnel and needed facilities.
2. A part of the engineering services, as set out in this plan.
3. Services needed to advertise, award, and administer the contract for the structure.
4. A part of the construction cost, as set out in the plan.

The structure will be installed during the first year of the project installation period.

The installation of the structure is contingent upon the following conditions:

1. Basic conservation plans are prepared on at least 50 percent of the farmland above the multiple-purpose structure.
2. Adequate land treatment above the structure has been installed.
3. All land, easements, and rights-of-way have been secured for the structure.
4. The contracting agencies are prepared to discharge their responsibilities.
5. Operation and maintenance agreements have been executed.
6. Federal funds are available.

The governing body of the Clear Creek Soil and Water Conservation District will encourage farmers to establish complete soil and water conservation programs on their farms.

The Agricultural Extension Service will assist with the educational phase of the conservation program through local meetings, radio and press releases, and other methods.





### FINANCING PROJECT INSTALLATION

Federal assistance will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666), as amended. This assistance is subject to appropriation of funds.

The cost of land treatment measures will be financed by the owners and operators of the land with aid from the Agricultural Conservation Program and other state and federal programs. The technical application assistance for the forest land treatment measures will be financed by the Arkansas Forestry Commission and is estimated at \$900. These services will be provided through the going Cooperative Forest Management Program, in cooperation with the U. S. Forest Service. The technical assistance cost for conservation planning and land use determination will be financed from the "going" Soil Conservation Service program (Public Law 46) and Public Law 566 funds. Public Law 566 funds are provided only for the acceleration of needed land treatment and soil surveys. The City of Alma will assume the entire local share of all costs necessary to install and operate and maintain the multiple-purpose structure.

Public Law 566 funds not to exceed 30 percent of the cost of the structure will be advanced to pay the construction and installation services costs allocated to future water supply, with repayment by the City of Alma beginning when the water is first used, or ten years after the year the structure is completed. The City of Alma will execute an agreement for repayment of the advance approved by the Farmers Home Administration before a project agreement for construction is executed. All local costs necessary to install the multiple-purpose structure, and not included in the deferred cost, shall be financed with a Public Law 566 loan administered by the Farmers Home Administration. Funds to repay the loans and to operate and maintain the structure will be paid from water, sewer, and other revenues collected by the City of Alma.

All structural measures costs allocated to flood prevention will be paid from Public Law 566 funds.

### PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be operated and maintained by landowners and operators cooperating with the local soil and water conservation district. Representatives of the district, the Soil Conservation Service, and the Arkansas Forestry Commission will make periodic inspections of land treatment measures, and the district will encourage farmers to perform needed maintenance.

The multiple-purpose structure will be operated and maintained by the City of Alma at an estimated annual cost of \$500. Representatives of the cosponsoring organizations will, after each heavy rain or at least annually, make maintenance inspections of the structure. A representative of the





Soil Conservation Service will participate in these inspections at least annually. Items which may need maintenance and which will be inspected will include, but will not be limited to, the condition of the vegetative cover on the embankment and emergency spillway, the need for removing trash and debris from around the principal spillway, and the condition of the fencing.

Provision will be made for free access of representatives of the sponsoring local organizations and the Soil Conservation Service to inspect and for the City of Alma to provide maintenance for the structure at any time.

The City of Alma will maintain a record of all maintenance inspections and maintenance performed and have it available for inspection by the Soil Conservation Service. The City of Alma fully understands its obligations for maintenance and will execute specific maintenance agreements prior to the issuance of invitations to bid on the construction of the multiple-purpose structure.



TABLE 1 - ESTIMATED PROJECT INSTALLATION COST  
Little Clear Creek Watershed, Arkansas

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Installation Cost Item	Unit	Number	Estimated Cost (Dollars) <sup>1/</sup>		
			Applied	P. L.	Other
			566 Funds	Funds	Total
<u>LAND TREATMENT</u>					
Soil Conservation Service					
Cropland	Acre	2,000	-	25,340	25,340
Pastureland	Acre	2,200	-	33,960	33,960
Rangeland	Acre	4,000	-	14,370	14,370
Wildlife Land	Acre	80	-	280	280
Technical Assistance			6,970	5,670	12,640
SCS Subtotal			6,970	79,620	86,590
Forest Service					
Woodland	Acre	438	-	1,500	1,500
Technical Assistance			-	900	900
FS Subtotal			-	2,400	2,400
<b>TOTAL LAND TREATMENT</b>			6,970	82,020	88,990
<u>STRUCTURAL MEASURES</u>					
Multiple-Purpose					
Floodwater Retarding					
and Municipal Water					
Supply	No.	1	590,575	356,162	946,737
Intake Structure and					
Raw Water Line			-	35,500	35,500
Subtotal - Construction			590,575	391,662	982,237
<u>Installation Services</u>					
Soil Conservation Service					
Engineering Services			106,303	69,044	175,347
Other			53,136	34,510	87,646
Subtotal - Installation Services			159,439	103,554	262,993
<u>Other Costs</u>					
Land, Easements, and Rights-of-Way			-	90,000	90,000
Administration of Contracts			-	4,300	4,300
Subtotal - Other			-	94,300	94,300
<b>TOTAL STRUCTURAL MEASURES</b>			750,014	589,516	1,339,530
<b>TOTAL PROJECT</b>			756,984	671,536	1,428,520
<u>SUMMARY</u>					
Subtotal SCS			756,984	669,136	1,426,120
Subtotal FS			-	2,400	2,400
<b>TOTAL PROJECT</b>			756,984	671,536	1,428,520

<sup>1/</sup> Price Base: 1964

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

(at time of work plan preparation)

Little Clear Creek Watershed, Arkansas

Measures	:	Unit	: Number :	: Applied: Total
	:		: to Date:	Cost <u>1/</u>
<u>Land Treatment</u>				
Brush and Weed Control		Acre	700	2,450
Conservation Cropping System		Acre	1,000	2,500
Contour Farming		Acre	150	260
Contour Orchard, Vineyards, and Small Fruits		Acre	100	18,500
Cover and Green Manure Crop		Acre	100	720
Crop Residue Use		Acre	1,500	3,750
Farm Pond		No.	90	18,000
Grasses and Legumes in Rotation		Acre	320	2,720
Land Clearing		Acre	150	9,000
Pasture and Hayland Renovation		Acre	400	8,000
Pasture and Hayland Planting		Acre	2,347	105,620
Pasture Proper Use		Acre	1,500	1,880
Row Arrangement		Acre	100	10
Rotation Grazing		Acre	1,500	220
Wildlife Habitat Preservation		Acre	200	20
Total Land Treatment			XXXXX	173,650
<u>Structural Measures</u>				
Levees and Channel Revetment				12,000
Total Structural Measures				12,000
TOTAL ALL MEASURES				185,650

1/ Price Base: 1964

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TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Little Clear Creek Watershed, Arkansas

(Dollars) 1/

Item	PURPOSE			Total
	:	:	:	
	Flood Prevention	Nonagricultural	Water Management	

COST ALLOCATIONSingle-Purpose

Intake Structure and Raw Water Line	-	42,900	42,900
--	---	--------	--------

Multiple-Purpose

Structure No. 1	808,838	487,792	1,296,630
TOTAL	808,838	530,692	1,339,530

COST SHARING

Public Law 566	750,014	-	750,014
Other	58,824	530,692	589,516
TOTAL	808,838	530,692	1,339,530

1/ Price Base: 1964

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TABLE 3 - STRUCTURE DATA - MULTIPLE-PURPOSE STRUCTURE NO. 1  
Little Clear Creek Watershed, Arkansas

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Item	Unit	Structure :	
		Number :	
		1	Total
Drainage Area	Sq. Mi.	14.53	14.53
Storage Capacity			
Sediment			
Sediment Pool	Ac. Ft.	340	340
Water Supply Pool	Ac. Ft.	25	25
Floodwater Pool	Ac. Ft.	25	25
Water Supply Pool	Ac. Ft.	3,250	3,250
Floodwater Pool	Ac. Ft.	5,000	5,000
Total	Ac. Ft.	8,640	8,640
Surface Area			
Sediment Pool	Acre	29	29
Water Supply Pool	Acre	121	121
Floodwater Pool	Acre	204	204
Volume of Fill	Cu. Yd.	1,155,856	1,155,856
Elevation Top of Dam	Foot (MSL)	556.2	XXXXXXXXXX
Maximum Height of Dam	Foot	112	XXXXXXXXXX
Emergency Spillway			
Crest Elevation	Foot	544.9	XXXXXXXXXX
Bottom Width	Foot	300	XXXXXXXXXX
Type	Veg.		XXXXXXXXXX
Percent Chance of Use		1.0	XXXXXXXXXX
Average Curve No. - Cond. II		75	XXXXXXXXXX
Emergency Spillway Hydrograph			
Storm Rainfall (6-hour)	Inch	12.12	XXXXXXXXXX
Storm Runoff	Inch	8.9	XXXXXXXXXX
Velocity of Flow ( $V_c$ ) $\frac{1}{2}$	Ft./Sec.	7.8	XXXXXXXXXX
Discharge Rate $\frac{1}{2}$	C.F.S.	4,800	XXXXXXXXXX
Maximum Water Surface Elevation $\frac{1}{2}$	Foot	548.3	XXXXXXXXXX
Freeboard Hydrograph			
Storm Rainfall (6-hour)	Inch	29.25	XXXXXXXXXX
Storm Runoff	Inch	25.5	XXXXXXXXXX
Velocity of Flow ( $V_c$ ) $\frac{1}{2}$	Ft./Sec.	16.0	XXXXXXXXXX
Discharge Rate	C.F.S.	36,600	XXXXXXXXXX
Maximum Water Surface Elevation	Foot	556.2	XXXXXXXXXX
Principal Spillway			
Capacity - Low-Stage	C.F.S.	250	XXXXXXXXXX
Capacity Equivalents			
Sediment Volume	Inch	0.50	XXXXXXXXXX
Detention Volume	Inch	6.45	XXXXXXXXXX
Spillway Storage	Inch	3.50	XXXXXXXXXX
Class of Structure		C	XXXXXXXXXX

$\frac{1}{2}$  Maximum during passage of hydrograph.



TABLE 4 - ANNUAL COST

Little Clear Creek Watershed, Arkansas

(Dollars)

	:	Amortization	:	Operation	:
	:	of	:	and	:
	:	Installation	:	Maintenance	:
Evaluation Unit	:	Costs <u>1/</u>	:	Costs <u>2/</u>	: Total

Multiple-Purpose

Structure No. 1	43,883	500	44,383
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TOTAL	43,883	500	44,383
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- 1/ Price Base: 1964 prices amortized for 100 years at 3.125 percent.  
2/ Long-term prices as projected by ERS, September 1957.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Little Clear Creek Watershed, Arkansas

(Dollars) 1/

Item	<u>:Estimated Average Annual Damage:</u>			Damage
	: Without	:	With	: Reduction
	: Project	:	Project	: Benefits
Floodwater				
Crop and Pasture	17,090		4,540	12,550
Other Agriculture	1,680		280	1,400
Nonagricultural				
Urban	1,550		-	1,550
Roads and Bridges	1,290		290	1,000
Subtotal	21,610		5,110	16,500
Sediment				
Sediment	2,210		910	1,300
Scour	4,740		2,210	2,530
Indirect	2,860		820	2,040
TOTAL	31,420		9,050	22,370

1/ Long-term prices as projected by ERS, September 1957.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

## Little Clear Creek Watershed, Arkansas

(Dollars)

Evaluation Unit	Multiple-Purpose	AVERAGE ANNUAL BENEFITS $\frac{\$}{\text{Year}}$									
		Flood Prevention	Nonagri- cultural	Management	Intensified Land Use	Municipal Water	Redevelopment	Secondary	Total	Average Annual Cost	Benefit- Cost Ratio
Structure No. 1		20,380	820	13,520	1,360	25,660	2,210	5,990	69,940	44,383	1.5:1
TOTAL		20,380 $\frac{2}{1}$	820	13,520	1,360	25,660	2,210	5,990	69,940	44,383	1.5:1

1/ Long-term prices as projected by ERS, September 1957.

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$1,990, annually.  
3/ From table 4.

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## INVESTIGATIONS AND ANALYSES

### Land Treatment

The conservation needs inventory, supplemented by a sampling of soil survey information, was used in determining the land capabilities of the watershed. A review of the basic conservation plans developed by landowners and operators in the watershed, augmented by a field study of representative farms, was used to determine land use and conservation measures. The Forest Service made a systematic field survey of forest land to determine ground cover, forest and hydrologic conditions, and treatment needs. This survey and information from other agencies and forestry officials was used to determine the needed remedial measures. The land treatment measures to be applied during the installation period were determined on the basis of the land treatment needed for watershed protection and flood prevention and the level of participation expected from landowners and operators. The cost of applying the needed conservation measures was obtained from work unit personnel, local agency representatives, forestry officials, and landowners and operators.

### Engineering

An engineering investigation was made to determine the physical feasibility of constructing the multiple-purpose structure at the planned location. A closed transit traverse and plane-table survey was made of the pool area. These data were used in developing a stage-storage table for the site. A detailed engineering field survey and preliminary geologic investigation was made at the emergency spillway location to determine the critical spillway velocity, required rights-of-way, and quantity of spillway rock excavation.

Engineering cost estimates were prepared from quantities developed from a preliminary structure design. The unit costs were based on bids obtained from recent similar Public Law 566 projects in Arkansas and costs obtained from the consulting engineer who was employed by the City of Alma. The consulting engineer's report entitled, "Proposed Water and Sewerage Improvements," contains additional engineering data.

### Hydrologic and Hydraulic

Basic climatological data were tabulated from United States Weather Bureau Climatological Bulletins, United States Geological Survey Water Supply Papers, and selected daily gage charts for the Mulberry, Arkansas, stream gage. These data were analyzed to determine average precipitation, the historical flood series to be used in project evaluation of agricultural reaches, and runoff-peak discharge relationships.





A 20-year historical storm series was tabulated from rainfall records at Mulberry, Arkansas. Based on cumulative departures from normal, the period 1940 through 1959, inclusive, was selected as a period of normal rainfall.

The present hydrologic condition of the watershed, excluding woodland areas mapped by the United States Forest Service, was determined by the use of existing soil information, work unit land use and land treatment records, and other pertinent information contributed by local area and work unit conservationists and soil scientists.

Consideration was given to other factors such as geology, cropping practices, topography, soil cover, and climate.

The future hydrologic condition was developed from data furnished by the work unit relative to expected changes in land use and expected land treatment program during the project installation period. Present and future soil cover complex curve numbers were computed from the above data to determine rainfall-runoff relationships.

The hydraulic and hydrologic analysis for the Alma urban area was made by the synthetic frequency method to determine depths and area flooded under "present" and "with project" conditions for the 2-, 5-, 10-, 25-, 50-, and 100-year frequency events.

Engineering surveys were made of 22 stream channel and valley cross sections of the main stem of Little Clear Creek. Locations of sections were selected to represent adequately the stream hydraulics, flood-plain area, and the needs of the economist and geologist. Cross sections in the urban area of Alma were located to reflect a true water surface profile throughout the urban area, especially near buildings and areas designated for industrial uses.

Determination was made of peak discharge and areas inundated which would occur under the present condition of the watershed and with the effect of all land treatment measures and with land treatment measures and the multiple-purpose structure.

Stage-discharge-area inundated relationships for valley cross sections were developed by computing water surface profiles by Doubt's Method using a computer program, as outlined in Technical Release No. 14.

Discharge-area inundated curves were developed for each evaluation reach by summing the area flooded, by depth increments, for each cross section in the evaluation reach.

The freeboard hydrograph and spillway hydrograph for the structure were developed by the distribution graph method according to Watershed Memorandum AK-301 using the 6-hour rainfall shown in Plates 2-C1 and 2-C2



for class "c" structures. The emergency spillway design for the structure was obtained by graphical flood routing method number 2, outlined in NEH-5, page 5.8-12. Minimum design criteria for the structure were exceeded with respect to the volume of detention storage and runoff amount used to design the emergency spillway and establish top of dam elevation.

The detention storage volume was determined using a multiple-day storm as outlined in Technical Release No. 10 with United States Weather Bureau Technical Publication Nos. 40 and 49.

The City of Alma employed a consulting engineering firm to make a recommendation for the municipal water storage volume required to meet future needs. This report, "Proposed Water and Sewerage Improvements for Alma, Arkansas," dated November 1964, prepared by James Mickle Associates, Fort Smith, Arkansas, recommended the volume of municipal water storage in the structure. A copy of this report with the city's approval was furnished to the Soil Conservation Service.

The 10-year frequency, present condition, estimated peak discharge in the urban area at reference valley section 14 is 7,776 c.f.s. The estimated modified peak discharge for this storm at the reference cross section is 1,804 c.f.s., a reduction of 76.8 percent.

The 100-year frequency, present condition, estimated peak discharge in the urban area at reference valley section 14 is 13,284 c.f.s. The estimated modified peak discharge for this storm at the reference cross section is 3,010 c.f.s., a reduction of 77.3 percent.

It is estimated that 200 urban acres are flooded by the 100-year storm between reference valley section 14 and the dam site. With the reduction in peak discharge of the 100-year event, the area of flooding will be reduced to a few acres.

The Arkansas State Highway Commission has planned four bridges and channel relocation on Little Clear Creek for the construction of Interstate Route 40 between the proposed dam site and the City of Alma. A copy of the plans was furnished the Soil Conservation Service for study as to the effect of the floodwater control structure will have on channel capacity. These plans call for the construction of: (1) approximately 1,600 feet of new channel with a 105-foot bottom width; (2) 2 double-lane concrete bridges, each 205 feet long; (3) 1 double-lane concrete approach bridge 167 feet long; and (4) 1 double-lane concrete approach bridge 158 feet long, all crossing Little Clear Creek.

A hydraulic analysis using a synthetic frequency method was made for the channel where the bridges are to be located. A 100-year and 50-year frequent event were used to determine the peak discharge under present and modified conditions with the flood control structure in operation.





The designed multiple-purpose structure provides floodwater detention capacity to contain the runoff of all storms up to and including the 100-year frequency event. For all events with a frequency occurrence of once in 100 years, or less, the modified discharge is determined by combining the discharge of the ungated principal spillway and the runoff of a 2-hour storm from the uncontrolled area.

The State Highway Commission uses the "flood of record" or a 50-year event, whichever is greater, for their design criteria. All recorded floods of record were less than a 50-year frequency event; therefore, a 50-year frequency event was used for the design evaluation purposes.

The existing flow conditions for a 50-year frequency event at the location of the proposed highway is 10,511 c.f.s. Future flow conditions, including the effect of the planned channel modification at the same location and of the same frequency with the project in operation, is 1,885 c.f.s., or a reduction of peak discharge of 82 percent.

The 50-year frequency channel flow would be contained in the proposed channel at a flow depth of approximately 4.0 feet. This low flow, due to structural control, could lead to redesign of the proposed channel and bridges or possibly be contained in box culverts, with a substantial saving to the highway construction cost.

The peak discharge and flow elevations of the 50-year event for this area under present conditions and under modified conditions were furnished to the Arkansas Highway Commission.

### Geologic

A preliminary investigation was made on the multiple-purpose dam site. This included studies of stratigraphy, geologic structures of the rock, ground water, and the depths of overburden at the site. These investigations included the use of a soil auger and a portable seismograph.

The geologic setting for this site occurs within Paleozoic interbedded shales and sandstones of the Atoka formation. The dip of the rock at the site is variable but very gently dipping beds with the dominant dip to the north. Mulberry Fault and a smaller hinge fault occur close to and downstream from the site; however, these ancient structures affect the rock at the dam site only in the fact that the intense pressure related to the faulting has caused the shales at the site to be thoroughly fractured with a millenia of minute fractures. These minute fractures are not expected to adversely affect the ability of the site to hold water.

A special effort was made to determine the depth to hard rock in the emergency spillway section of the structure. This was done with the portable seismograph, hand auger, and by visual inspection of the rock units.



The structure (dam) will be made of a combination of earth and rock fill. Ample borrow material is available; the foundation is ample to support the structure, and the spillway is located in a suitable site.

It is recommended that detailed investigations be made on the multiple-purpose site using the appropriate power equipment to sample and investigate the borrow, foundation, and spillway sections of the site.

### Sedimentation

Studies were made to determine the rate of erosion occurring in the uplands of the watershed, the rate of sedimentation which would affect the reservoir storage, and the rates of scour and overbank deposition affecting the flood plain.

Field mapping with aerial photographs supplied information needed to determine the rates of erosion taking place in the uplands above the multiple-purpose structure site. Delivery ratios of sediment to the site and the trap efficiency (of sediment) of the site were computed by considering the physical nature of the topography, climate, sediment, and the amount of storage in the site. The average annual erosion rate taking place in the uplands under present conditions is 1.76 tons of soil loss per acre. It is expected that the planned conservation practices and land treatment will reduce the rate of erosion to approximately 1.5 tons per acre, annually. Storage for sediment was designed into the reservoir in accordance with these rates.

Sediment and scour damages to the flood plain were measured by visual observation and field mapping using aerial photographs and profiles of valley cross sections. The Little Clear Creek valley has a sharply defined flood plain with inadequate channel capacities in the lower reaches of the watershed; consequently, the valley damages caused by scour and overbank deposition have caused serious problems. The proposed project, as outlined in this work plan, will not completely eliminate flooding, but it will eliminate over half of the valley damages by control of the sediment, by reducing the area flooded and the velocity, depth, duration, and turbulence of the floodwater. Thus, in time, the land will heal as it accumulates organic matter and fertility through proper cultivation and vegetation. Valley deposition on the bottomlands is estimated to be equivalent to an average annual loss of production of \$12,970.

The following material was used in the development of the sedimentation investigations for this work plan:

1. Technical Release No. 12 - Procedures for Computing Sediment Requirements for Retarding Reservoirs, SCS, September 1959.





2. Watershed Memorandum AK-10 - Sediment Storage Requirements and Allocation of Sediment in Floodwater Retarding Structures.
3. Watershed Memorandum AK-11 - Sediment Investigations in Work Plan Development.

### Economic

Collection of Data - Agricultural damage estimates were based on field schedule information obtained from owners and operators of flood-plain property. About 40 percent of the people having property subject to damage were interviewed. Information collected in the field included the present land use, crop distribution and yields, restrictions in land use and cultural practices because of flooding, probable shifts in land use after project installation, and information pertaining to trends in agricultural production and mechanization. Information was also collected to determine the frequency of flooding, severity and extent of crop damage, and the extent and location of other agricultural and nonagricultural damages.

Because of the necessity to measure crop damages with reference to crop seasons and adjust damages for recurrent flooding, the historical method of analysis was used.

In calculating crop and pasture damage, the cost of harvesting and other production inputs were deducted from the gross value of the damage. Estimates of flood-free yields were based on data obtained from schedules supplemented by information from other agricultural workers in the area and from other secondary sources. Because field investigations revealed that crop damages were related to depth of flooding, Economics Memorandum AK-108 was used to obtain the damage factors used in evaluation.

Information on other agricultural damages such as farm fences, livestock, and debris removal was determined from analysis of damage schedules correlated with the size of floods.

Road and bridge damage estimates were based on information describing the physical damage to roadbeds and surface material. Records disclosing the amount of public funds expended for road repairs in the flood plain because of flooding were not available.

The monetary value of the physical damage to the flood plain from scour and overbank deposition of sediment was based on the loss in net income taking into account appropriate discount for the extent of and time required for recovery. The reduction in sediment rates by land treatment, the area behind the structures, the estimated trap efficiency of the structures, and the reduction in area flooded were considered in determining the reduction of damage from overbank deposition. Reduction in scour





damage was determined by assigning appropriate scour power factors to the area flooded by different depth increments. These weighted figures as they compared to conditions without a project gave a percent of present scour damage that would remain after project installation. Their difference was considered a benefit.

Damage estimates for urban evaluation purposes were based on schedules obtained from all owners and operators of flood-plain property. Intensive investigations were considered necessary in view of the variation in type and location of the property subject to damage. From the information collected, stage-damage curves were developed. Estimates of damage were made for floods exceeding the experienced floods to arrive at the damage expected from the entire range of damage-producing floods.

Determination of Benefits - Average annual damages were calculated for conditions without a project, with planned land treatment installed, and with the structure installed. The difference between the damage remaining after each group of measures and the damage before its installation constitutes the benefits creditable to that group. This formed the basis on which damage reduction benefits were assigned to the measures producing them. Adjustments for recurrent flooding were made in crop and pasture damage after each increment of evaluation. The conversion to long-term prices for both agricultural and nonagricultural damages was made after each increment of evaluation.

Some benefits will accrue on the main stem of Clear Creek below the confluence of Little Clear Creek and the Arkansas River as a result of this project. These benefits were not evaluated.

Enhancement Benefits - There are an estimated 154 acres of undeveloped land in Alma that flood too frequently to risk intensive development, but which would be flood-free from the 100-year frequency flood under project conditions. Interviews with local people and discussions with personnel with the City Planning Division, University of Arkansas, revealed that this area has been designated for commercial, industrial, and residential development. The analysis of benefits to be realized from protecting this area was based on the expected increase in land values. Since a local market for this type of property has not been established, the recorded sales of other property in other locations for similar uses were used to indicate the increase in land values expected from flood protection. A recent purchase by a commercial investor was not used as this property was considered special-purpose and, consequently, would not be indicative of enhanced values of the adjoining land. The annual equivalent amount of the increased land value was considered a project benefit. This area is exclusive of the area on which benefits from reduction of damages to future development without a project have been claimed. It also excludes the area on which reduced development cost benefits were claimed.



Enhancement benefits in the agricultural portion of the flood plain were based on information received from interviews and reflect the intentions of farmers after consideration of reduced flooding and land capability. Associated costs were deducted from the gross benefit to arrive at net benefits. Both the changed land use and the intensified land use benefits were discounted for five years to allow for a buildup to their full level. Damage to the higher values was deducted to account for the effects of the remaining flooding.

Redevelopment Benefits - In analyzing redevelopment benefits, consideration was given to the proportion of the construction costs that are being expended for labor in similar type construction in Arkansas. Recent construction experience indicates that labor costs range from 6 to 8 percent of contract costs. However, due to the relative amount of skilled to unskilled labor required in this type of construction, it was considered that 5 percent of the costs would be more appropriate in this case. Redevelopment benefits resulting from the operation and maintenance of structural measures were estimated to be 50 percent of the total cost during the first 20 years. Benefits from operation and maintenance were treated as a decreasing annuity. Appropriate discounting factors were used to bring these benefits to present worth.

Redevelopment benefits from the use of underemployed and unemployed local labor will be utilized in the development of the enhanced property brought about by the project. However, no assurance could be obtained as to the exact type of development, time of construction, and the associated labor requirements; consequently, benefits from the utilization of labor for development purposes were not determined.

Secondary Benefits - The analysis of secondary benefits was based on primary benefits stemming from the project, together with the increased costs of producing the additional goods induced by the project. A factor of 10 percent was used in each case. Indirect primary benefits and redevelopment benefits were excluded in calculating secondary benefits.

Municipal Water Supply Benefits - Storage of water for municipal and industrial use was included as a purpose in this work plan. The "Engineering Report" on proposed water and sewage improvement of the City of Alma, submitted by James Mickle Associates, provided the basis for the benefit-cost analysis for the municipal storage included in the structure.

Project Costs - Project installation costs were amortized for 100 years at 3.125 percent interest. Operation and maintenance costs were converted to 1957 long-term price levels, as projected by ERS, September 1957. Engineering contingency costs were estimated to be 10 percent of the engineer's estimate. All engineering and other installation services costs were computed as set forth in Watersheds Memorandum AK-13.





The cost of land, easements, and rights-of-way necessary for project installation was determined by individual appraisal in cooperation with local representatives. Consideration was given to the value and size of land ownership where the structure is to be located.

The annual net loss of production and associated secondary losses, based on long-term prices, within the structure, were calculated and this value compared with the amortized cost of the appraised land value. In this determination, it was assumed that under project conditions, land within the sediment pool and municipal pool would have no productive value and that cropland in the detention pool would be converted to grassland. The amortized cost of land exceeded the net loss in production; consequently, no other economic costs will be incurred.



Table A - Summary of Primary Benefits from Changed and  
Intensified Land Use  
 Little Clear Creek Watershed, Arkansas  
 1963 Prices

41

Land Use	: Unit :	Acres	Without Project			
	: of :		: Yield :	:	:	:
	: Produc-:		: Per :	: Gross :	: Production:	: Net
	: tion :		: Acre :	: Income :	: Cost :	: Return
				(dollars)	(dollars)	(dollars)
Soybeans	Bu.	5	30	380	145	235
Meadow	Ton	30	2.2	1,577	654	923
Pasture						
Improved	AUM	140	3.5	1,200	346	854
Unimproved	AUM	30	2.5	184	50	134
Woods	-	40	-	-	-	-
<b>TOTAL</b>		<b>245</b>	<b>-</b>	<b>3,341</b>	<b>1,195</b>	<b>2,146</b>

Land Use	: Unit :	Acres	With Project			
	: of :		: Yield :	:	:	:
	: Produc-:		: Per :	: Gross :	: Production:	: Net
	: tion :		: Acre :	: Income :	: Cost :	: Return
				(dollars)	(dollars)	(dollars)
Corn						
Grain	Bu.	10	45	558	330	228
Silage	Ton	30	8	1,752	1,248	504
Grain Sorghum	Cwt.	20	22	871	387	484
Oats	Bu.	40	50	1,680	1,020	660
Tomatoes	Cwt.	5	60	2,370	1,083	1,287
Pasture						
Improved	AUM	140	5.5	1,886	693	1,193
<b>TOTAL</b>		<b>245</b>		<b>9,117</b>	<b>4,761</b>	<b>4,356</b>

Increased Net Return With Project - 1963 Prices	2,210
Increased Net Return With Project - Long-Term	2,604
Discounted Increased Net Return (Gross Benefit	2,406
Less Associated Cost	146
Less Additional Damage to Higher Values	80
Average Annual Benefit <u>1/</u>	<u>2,180</u>

1/ Changed Land Use           \$ 820  
 Intensified Land Use - \$1,360

December 1964



Table B - Summary - Cost Allocation and Cost Sharing

Little Clear Creek Watershed, Arkansas

(Dollars) 1/

	Flood Prevention			Nonagricultural Water Management			Recapitulation		
	Public Law	Other	Total	Public Law	Other	Total	Public Law	Other	
	566 Funds	Funds		566 Funds	Funds		566 Funds	Funds	
Engineer's Estimate	536,886	-	536,886	-	323,784	860,670	536,886	323,784	
Contingencies	53,689	-	53,689	-	32,378	86,067	53,689	32,378	
Total Construction Cost	590,575	-	590,575	-	356,162	946,737	590,575	356,162	
Engineering Services	106,304	-	106,304	-	64,109	170,413	106,304	64,109	
Other Installation Services	53,135	-	53,135	-	32,045	85,180	53,135	32,045	
Easements and Rights-of-Way	-	56,142	56,142	-	33,858	90,000	-	90,000	
Administration of Contracts	-	2,682	2,682	-	1,618	4,300	-	4,300	
Total Installation Cost	750,014	58,824	808,838	-	487,792	1,296,630	750,014	546,616	
Percent to Purpose			62.38	-	37.62	100.00			
Percent Cost Sharing	92.73	7.27	100.00	-	100.00		57.84	42.16	

1/ Price Base: 1964.

December 1964





# City of Alma

EXHIBIT I

43

OFFICE OF THE MAYOR

ALMA, ARKANSAS

December 22, 1964

Mr. William B. Davey  
State Conservationist  
Soil Conservation Service  
Department of Agriculture  
5401 Federal Office Building  
Little Rock, Arkansas 72201

Re: Multi-Purpose Structure  
Little Clear Creek  
Crawford County, Arkansas

Dear Mr. Davey:

This is with further reference to the studies that have been made by the City of Alma and the Soil Conservation Service in connection with subject project.

It is our understanding that the total estimated cost of this multi-purpose structure is \$1,296,630 and that the city's share of this cost is estimated to be \$546,616, and that the total storage to be provided is 8639 acre feet of which 389 acre feet is sedimentation storage, 3250 acre feet is for municipal water supply and 5000 acre feet is for flood control purposes.

The city has retained the engineering firm of James Mickle Associates to determine the need for a surface water supply and the feasibility of participating in the construction of subject structure. The engineering firm has presented their report to the city and based upon this report and studies made by the officials of the city, we have reached the following conclusions:

1. The City of Alma must develop a surface water supply if it is to be assured of sufficient water to provide for the growth anticipated in the future. The average daily water usage in the city will increase from 430,000 gpd in 1963 to an estimated 750,000 gpd in 1975 and to an estimated 1,750,000 gpd in 2005. To provide for this water usage, 3250 acre feet of storage is required in the subject reservoir.



2. The studies made by our engineers included a study of the streams surrounding the City of Alma as a source of surface water. The only site satisfying the requirements of an economical dam site, sufficient drainage area, and an economical feasible transmission line was the site of the proposed multi-purpose structure.

Developing this site for the sole purpose of providing a municipal water system was estimated by our engineers to cost \$783,280. As the city's share of the multi-purpose structure is only \$546,616, participation in the multi-purpose structure will result in a saving to the city of \$236,664.

3. The city has made application to the Housing and Home Finance Agency and to the Department of Health, Education and Welfare for grants under the Accelerated Public Works program to assist in the financing of the proposed multi-purpose structure and other water and sewer improvements.

The city cannot be assured of receiving grants under the Accelerated Public Works program and therefore requested the engineers to provide for two methods of financing the proposed improvements. These two proposals are presented in the engineering report as Method A and Method B.

Under Method A the city intends to construct the improvements and intends to financially participate in the cost of the multi-purpose structure whether APW grants are received or not.

The Method B proposal is the most desirable for the city because it would permit the immediate development of a surface water supply while under Method A, in which no grants would be received, the full development of a surface water supply would have to be deferred until 1975.

Under Method A an increase in the water rates will be required in 1965 and another increase in rates will be required in 1975. The city will adopt such water and sewer rates as are necessary to finance the proposed improvements. For the details of the financing under Method A and Method B, please refer to the enclosed engineering report.

4. The city is in urgent need of a surface water supply and as the most economical source of supply available is by participation in the subject multi-purpose structure, the city will participate in the cost of this multi-purpose structure and intends to utilize water from this structure not later than 1975.





Mr. Davey  
Page 3  
December 22, 1964

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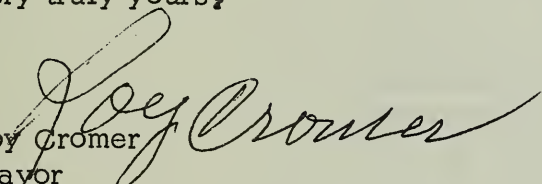
If grants can be received under the APW program, the city will commence using water from the multi-purpose structure at its anticipated completion in 1966. It is estimated that the city in 1966 will use approximately 525,000 gpd, and this usage will increase to 750,000 gallons in 1975 and 1,750,000 gallons in the year 2005.

If APW grants cannot be obtained for this project, the city wishes to defer the project cost if possible. It is our understanding that based upon the estimated construction and installation services cost of \$1,202,330 that the city will be permitted to defer \$360,699 and will need to expend \$185,917 in 1965.

The city understands that not later than 1975 they must assume their obligation for the deferred cost of \$360,699. If grants can be made available, the city wishes to defer a portion of the costs and pay only for the portion of the water used. It is the city's understanding that under this plan the city will be obligated to pay for 42.86 percent of their total cost plus land, easements, and rights-of-way and administration of contracts.

Based upon the estimated project cost, the city would be responsible for \$288,162. The city further understands that they would have to assume the balance of their obligation, \$258,454, not later than 1975 or when their water usage exceeds 750,000 gpd.

Very truly yours,

  
Roy Cromer  
Mayor

RC/t



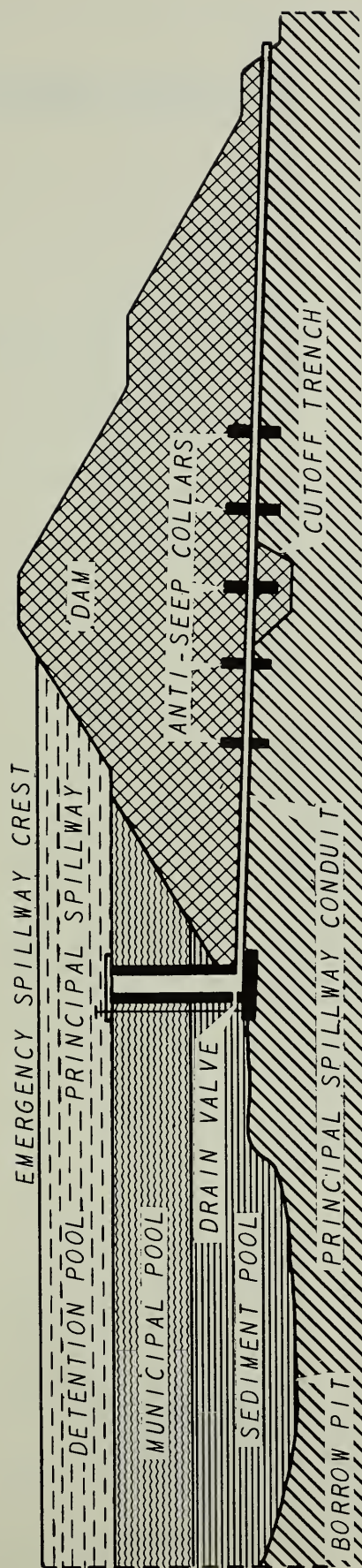
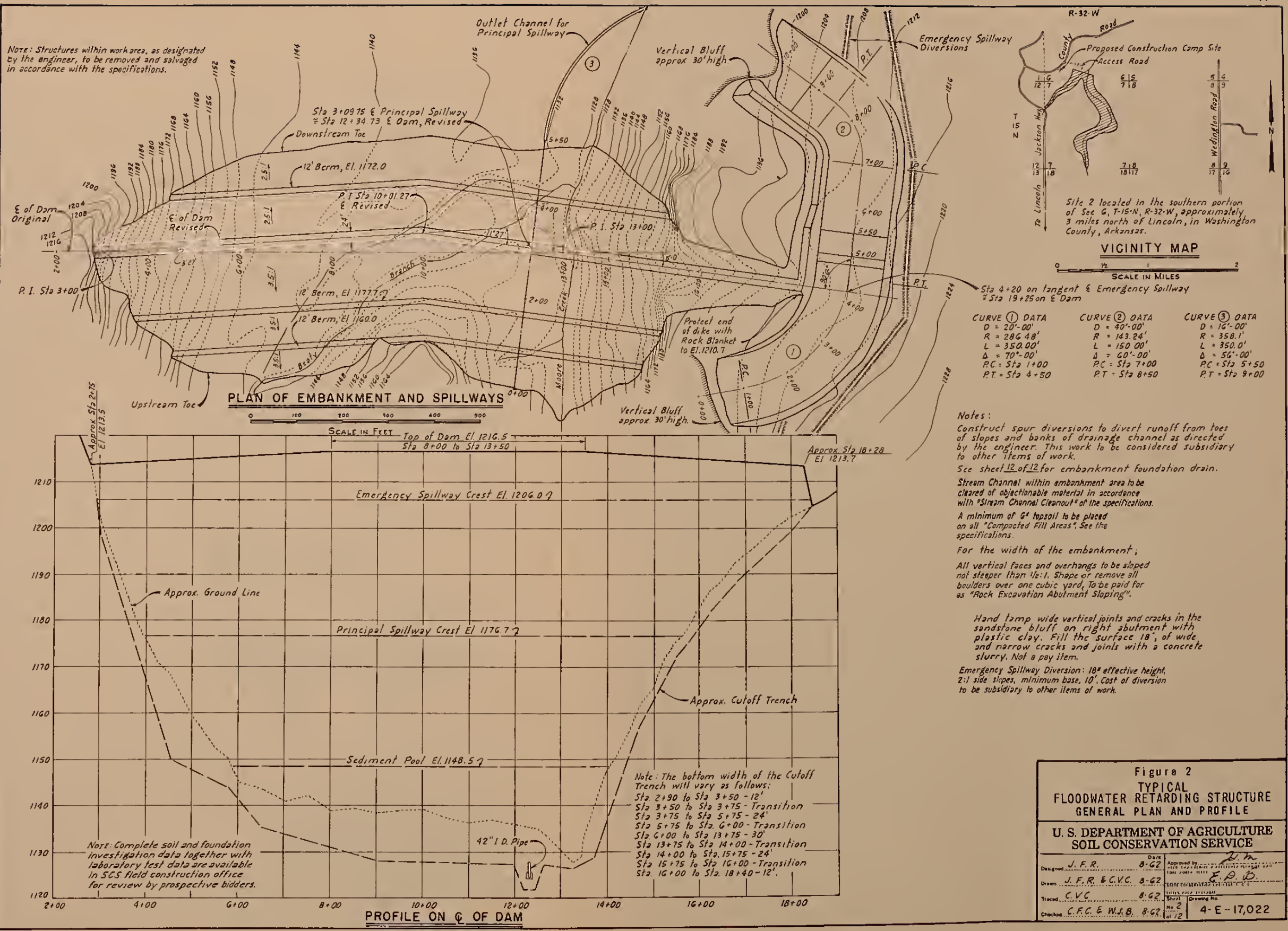


Figure 1  
SECTION OF A TYPICAL MULTIPLE PURPOSE STRUCTURE







**Figure 2**  
**TYPICAL**  
**FLOODWATER RETARDING STRUCTURE**  
**GENERAL PLAN AND PROFILE**

**U. S. DEPARTMENT OF AGRICULTURE**  
**SOIL CONSERVATION SERVICE**

Designed <b>J. F. R.</b>	Date <b>8-62</b>	Approved by <b>[Signature]</b>
Drawn <b>J. F. R. &amp; C. V. C.</b>	Scale <b>8-62</b>	Checked <b>E. D. D.</b>
Traced <b>C. V. C.</b>	Sheet <b>8-62</b>	Drawing No. <b>4-E-17,022</b>
Checked <b>C. F. G. &amp; W. J. B.</b>	of 12	





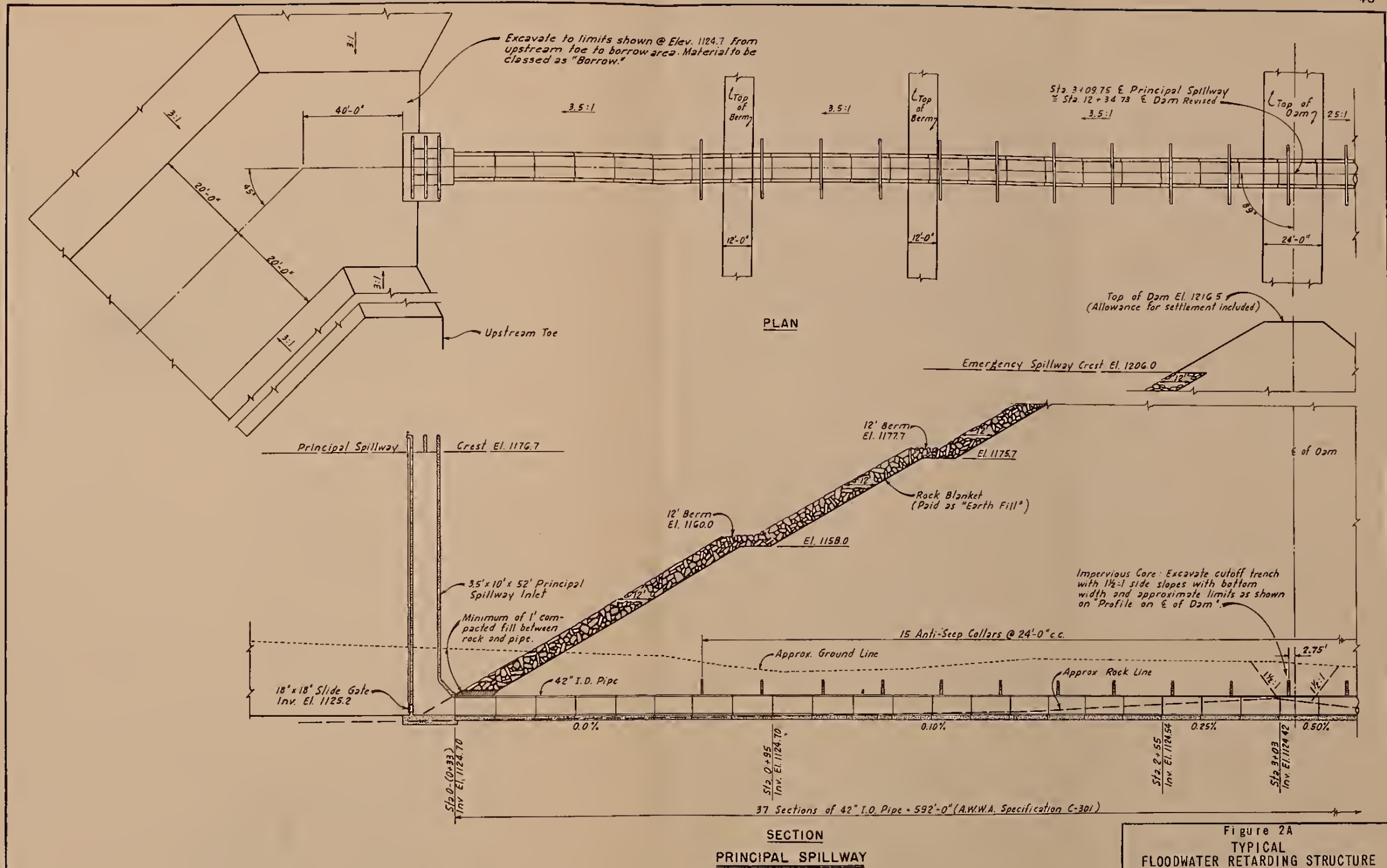
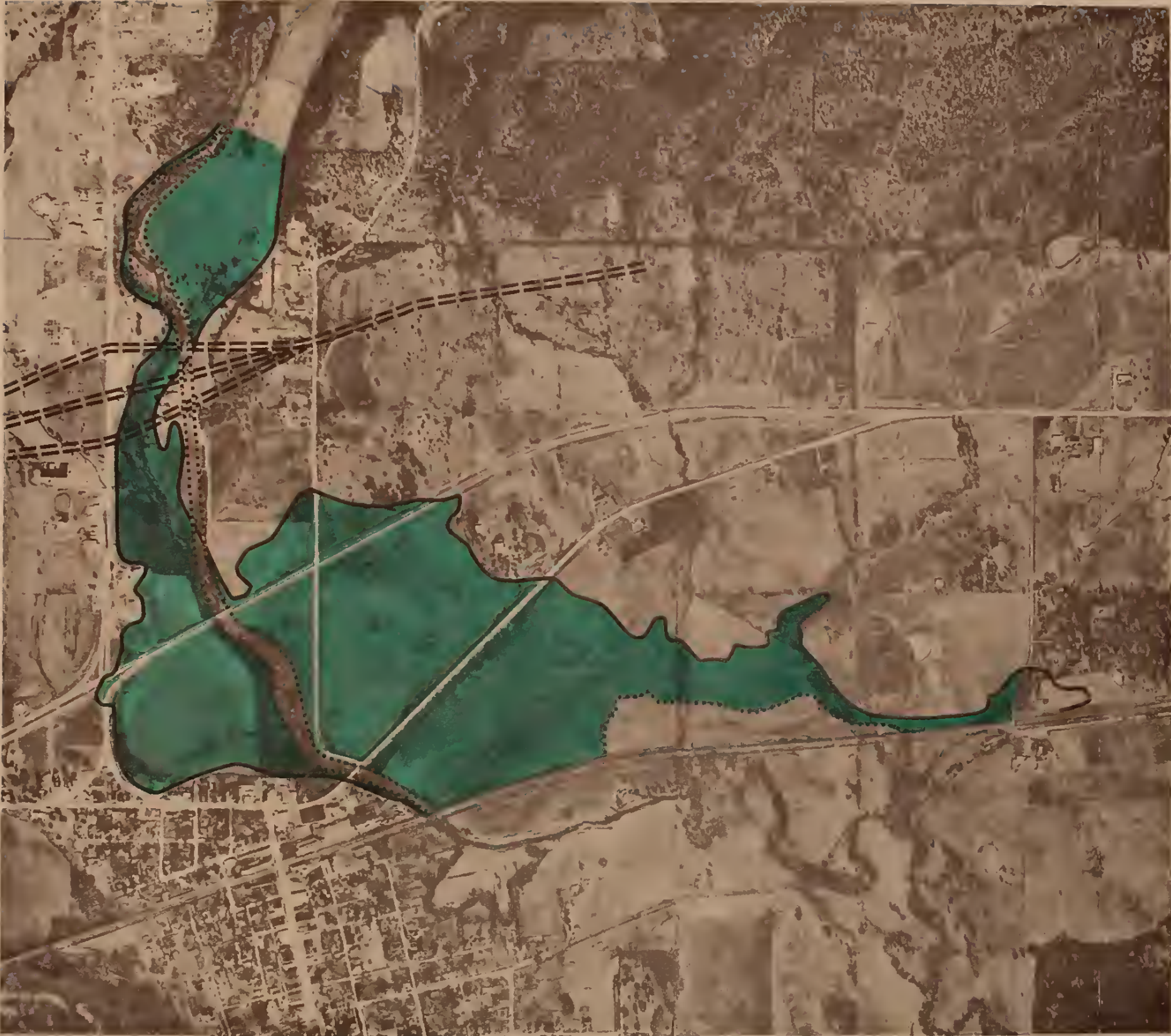


Figure 2A  
TYPICAL  
FLOODWATER RETARDING STRUCTURE  
STRUCTURE PLAN AND SECTION  
U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

Designed	J.F.R.	8-62	Approved by	R.M.
Drawn	J.F.R. & C.V.C.	8-62	Checked by	E.B.D.
Traced	C.V.C.	8-62	Little Rock, Arkansas	
Checked	C.F.C. & W.J.B.	8-62	Sheet	4-E-17,022







USDA-SCS-FORT WORTH, TEX. 1965

LEGEND

- Expected Flood Line of 100-Year Frequency Flood Without Project
- Expected Flood Line of 100-Year Frequency With Project
- Significant Areas from which Land Enhancement Benefits are Expected
- Interstate Route 40



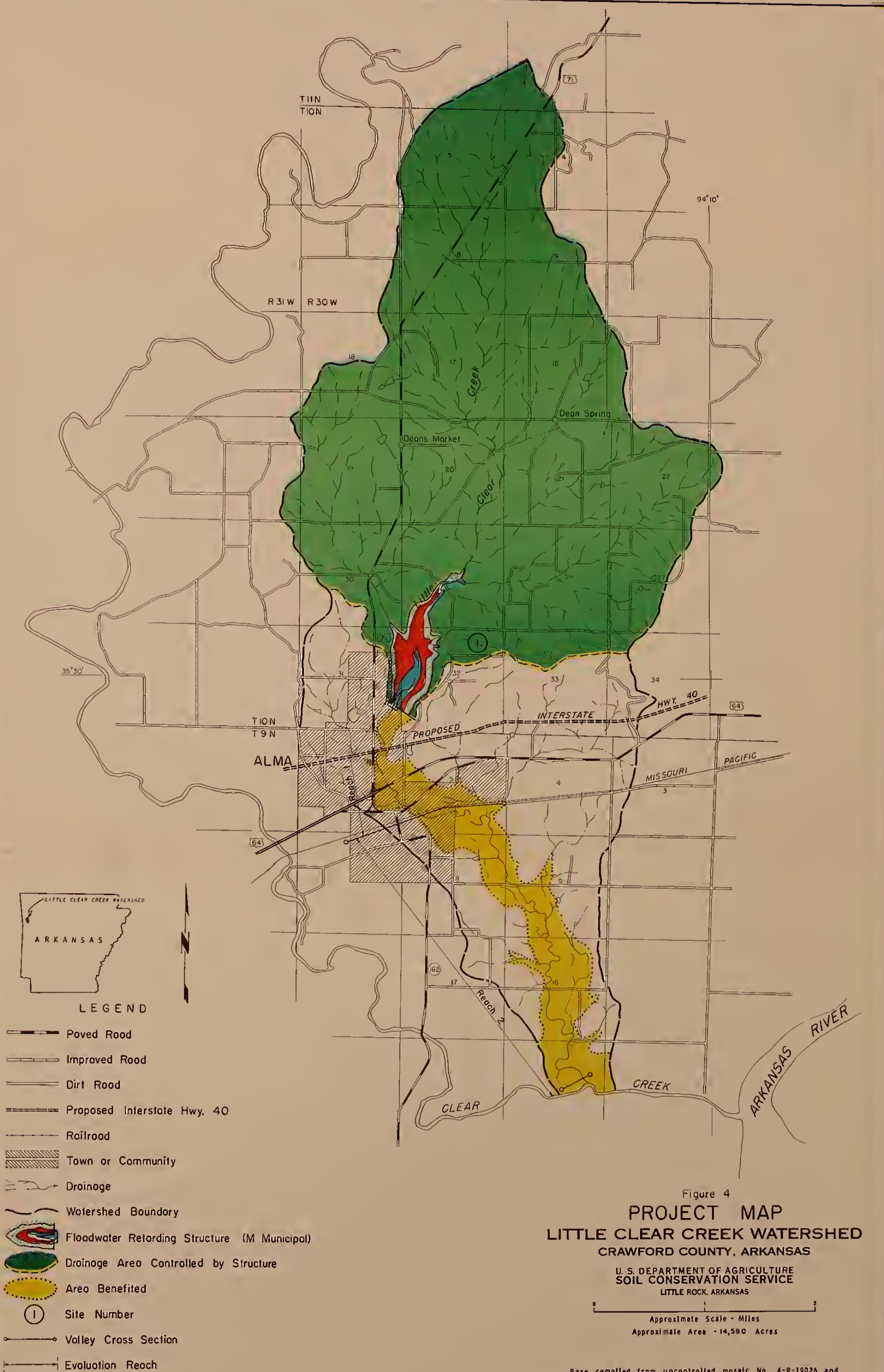
0 1000 2000 Feet

Figure 3  
URBAN BENEFIT AREA  
ALMA, ARKANSAS  
LITTLE CLEAR CREEK WATERSHED  
Crawford County, Arkansas  
U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
Little Rock, Arkansas





USDA-SCS-FORT WORTH, TEX. 1965





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